Fourhorn Sculpin

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Chapter 5 Fourhorn Sculpin

Results

Relative Abundance and Distribution

The following discussions of relative abundance and distribution of fourhorn sculpin result from two approaches to analyzing the spatial and temporal variation in catch rates (fish/d). The first analysis employed a two-way ANOVA which addresses the overall relative contribution of years and sampling areas as sources of variation in CPUE over the 4-year study period. The second set of analyses addresses the spatial and intraseasonal variation observed in catch rates of fourhorn sculpin within each sampling year.

Two-way ANOVA.— Results of the two-way analysis of variance are presented in Table 5.1. The main effects for year, sampling area, and the interaction term were all highly significant ($P < 0.0034$). The overall success of the model in explaining the variation in catch rates was poor ($R^2 = 0.16$). The main effects were of relatively equal explanatory value in the model as indexed by the apportionment of sums of squares. That is, from 1988 to 1991, sampling year and area were similar overall sources of variation in catch rates of fourhorn sculpin. Changing the order of entry of the dependent variables into the computer algorithm did not alter the relationship. The significant interaction term invalidated interpretation of the main effect means comparisons and few clear patterns emerged from the comparisons for the year × area interaction levels (Table 5.1).

Spatial differences.— Within-year comparisons of daily catch rates (fish/d) among net stations indicated little spatial variability in the relative abundance of fourhorn sculpin (Table 5.2; Figure 5.1). In all years, there were no significant differences between daily catch rates for net stations KL05, KL10, JL12, JL14. During 1988, net stations SC01 and PB02 daily catch rates did not differ from all other net stations. Net station PB01 daily catch rates were lower than those for net stations KL05, JL12, and JL14. There were no differences among any catch rates during 1989. During 1990 net station SC04 had higher daily catch rates than net stations SC01, KL10, and BL04. Net station BL04 was lower than all other net stations during 1990. During 1991 net stations KL05, KL10, JL12, JL14, and BL02 did not differ. Net station SC04 had higher catch rates than net stations SC01, BL02, and BL04. Net station BL04 had lower catch rates than all other net stations.

We noted few differences among sampling area catch rates for fourhorn sculpin. In each year, there were no differences between daily catch rates for Kaktovik and Jago lagoons (Table 5.3; Figure 5.2). Simpson Cove catch rates were lower than those for Jago Lagoon in 1988, and Kaktovik Lagoon in 1990. In 1989 and 1991, Simpson Cove catch rates did not differ from those for Kaktovik and Jago Lagoons. In the eastern most sampling area (Pokok Bay, in 1988, and Beaufort Lagoon in 1990, and 1991) daily catch rates were lower

TABLE 5.1.– Two factor analysis of variance on log-transformed catch rates (ln (CPUE+1)) and Tukey means comparisons for fourhorn sculpin from coastal waters of the Arctic Refuge. Effects followed by the same letter are not significantly different ($P > 0.05$). $Mean_g$ = geometric mean.

Source	df	Sum of squares	Mean square	*F*-value	*P*-value
Model					
Year	3	132.69	44.23	35.42	0.0001
Area	3	148.19	49.40	39.56	0.0001
Year×Area	7	26.68	3.81	3.05	0.0034
Error	1281	1599.49	1.25		
Total	1294	1907.05			

Year	$Mean_g$	Tukey grouping
1989	4.43	A
1990	3.89	B
1991	3.75	B
1988	3.48	C

Area	$Mean_g$	Tukey grouping
Jago	4.17	A
Simpson	4.09	A
Kaktovik	4.04	A
Beaufort	3.12	B

Year×Area	$Mean_g$	Tukey grouping			
1989-Jago	4.52	A			
1989-Kaktovik	4.46	A	B		
1990-Simpson	4.42	A	B		
1989-Simpson	4.32	A	B		
1990-Jago	4.20	A	B	C	
1991-Kaktovik	4.01	A	B	C	D
1991-Jago	3.99	A	B	C	D
1991-Simpson	3.92		B	C	D
1990-Kaktovik	3.92		B	C	D
1988-Kaktovik	3.64	E		C	D
1988-Jago	3.56	E			D
1990-Beaufort	3.13	E			
1991-Beaufort	3.11	E			
1988-Simpson	3.08	E			

TABLE 5.2.– Comparison of daily CPUE (fish/d) observations between fyke net stations for fourhorn sculpin in Arctic Refuge coastal waters, 1988-91. Within each year those net stations with the same letter are not significantly different (Kruskal-Wallis test with Scheffé multiple comparisons). Net stations with dashed lines were not fished within that year.

	Within year Scheffé groupings			
Station	1988	1989	1990	1991
SC01	A,B	A	B	C
SC04	--	A	A	A
KL05	A	A	A,B	A,B
KL10	A,B	A	B	A,B,C
JL12	A	A	A,B	B,C
JL14	A	A	A,B	A,B
PB01	B	--	--	--
PB02	A,B	--	--	--
BL02	--		A,B	B,C
BL04	--		C	D

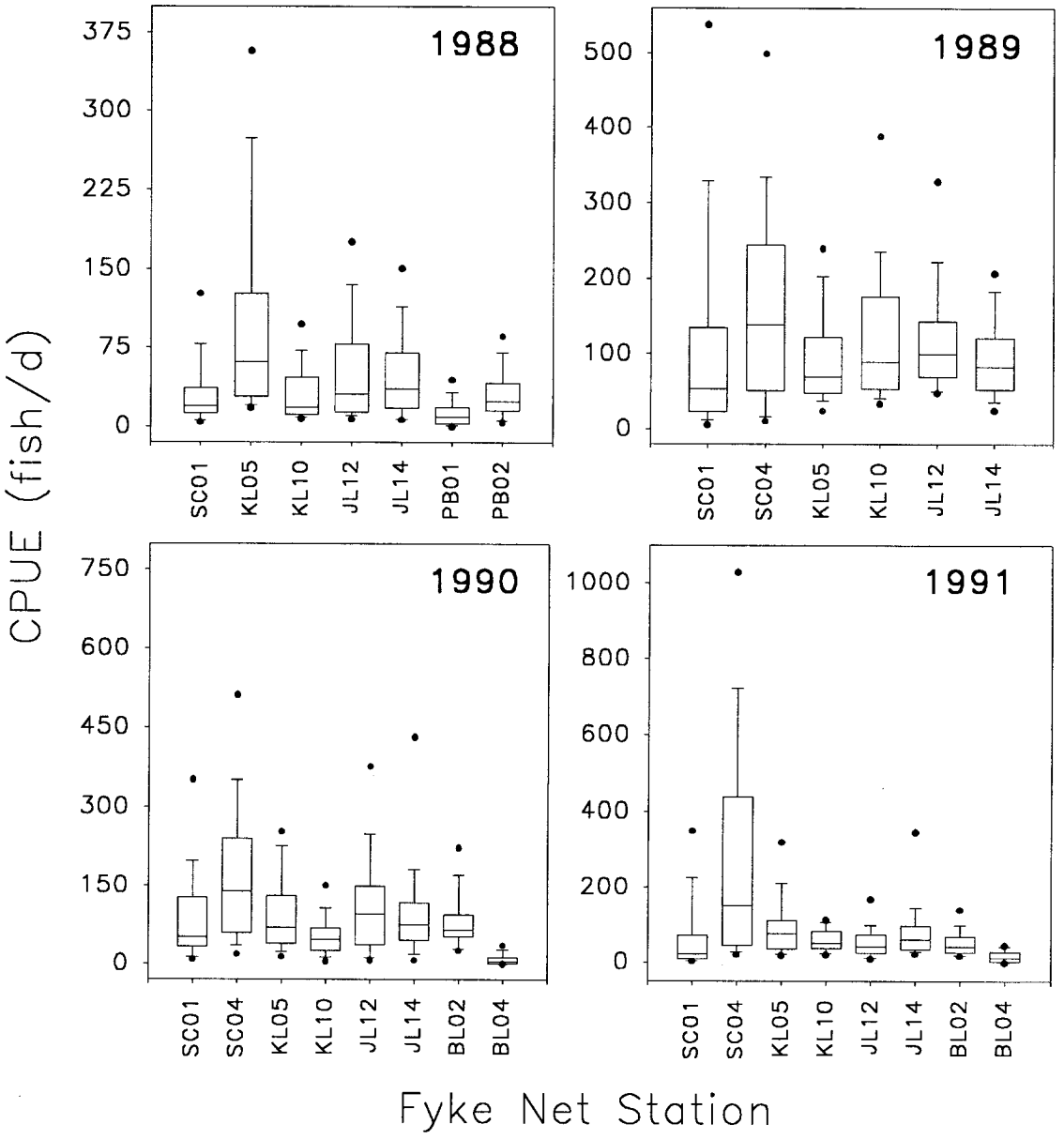

FIGURE 5.1.– Boxplots comparing daily CPUE (fish/d) observations between net stations for fourhorn sculpin in Arctic Refuge coastal waters, 1988-91.

TABLE 5.3.– Comparison of daily CPUE (fish/d) observations between sampling areas for fourhorn sculpin in Arctic Refuge coastal waters, 1988-91. Within each year those sampling areas with the same letter are not significantly different (Kruskal-Wallis test with Scheffé multiple comparisons). Sampling areas with dashed lines were not fished within that year.

	Within year Scheffé groupings			
Sampling area	1988	1989	1990	1991
Simpson Cove	B,C	A	A	A
Kaktovik Lagoon	A,B	A	B	A
Jago Lagoon	A	A	A,B	A
Pokok Bay	C	--	--	--
Beaufort Lagoon	--		C	B

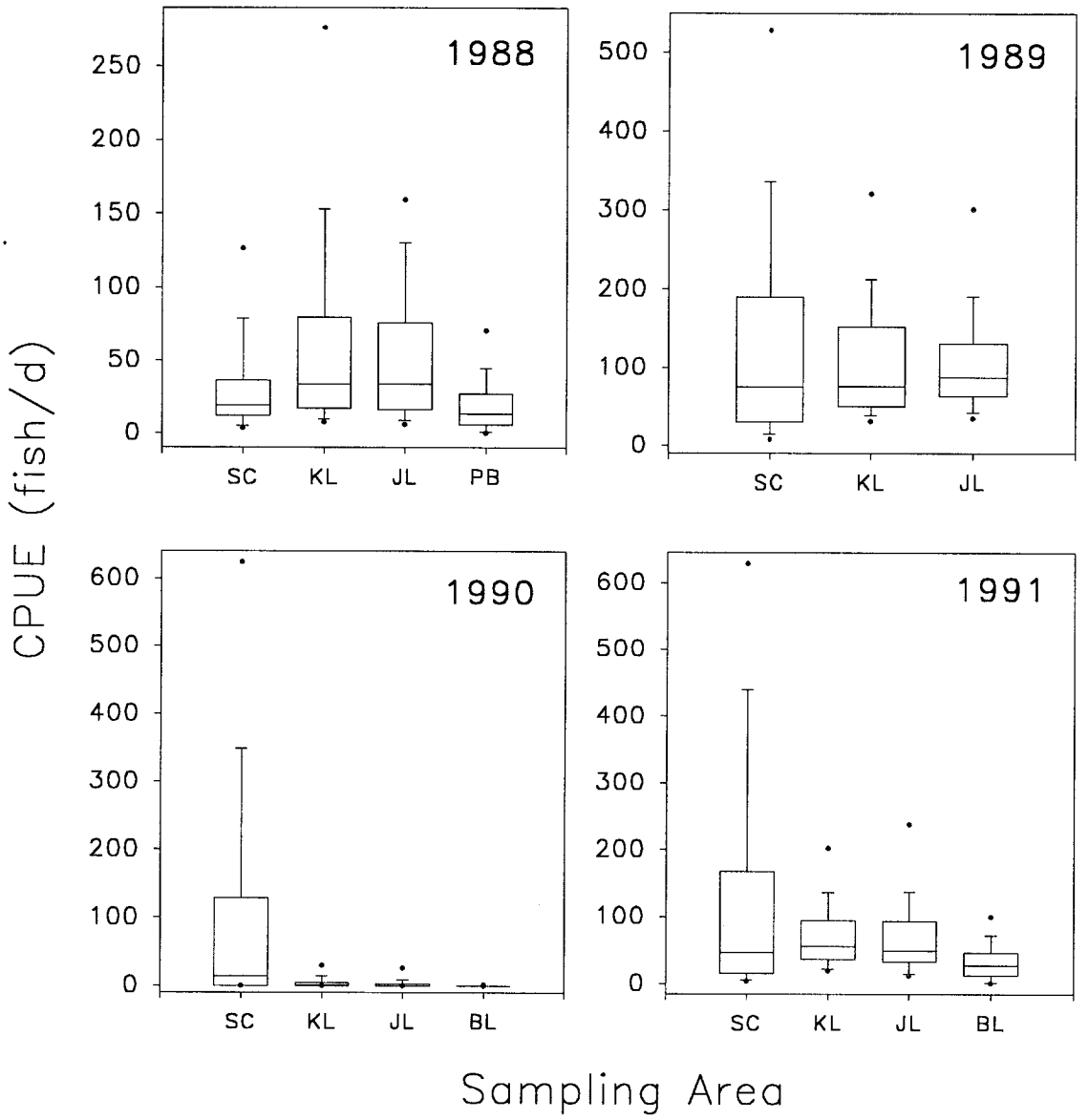

FIGURE 5.2.– Boxplots comparing daily CPUE (fish/d) observations between sampling areas for fourhorn sculpin in Arctic Refuge coastal waters, 1988-91. SC = Simpson Cove; KL = Kaktovik Lagoon; JL = Jago Lagoon; PB = Pokok Bay; BL = Beaufort Lagoon.

than those in Kaktovik and Jago lagoons (Table 5.3; Figure 5.2). Beaufort Lagoon catch rates were lower than all other sampling areas during 1990 and 1991.

Temporal differences.— Comparisons between fourhorn sculpin daily catch rates within each year indicated little temporal variability. Station SC01 CPUE was relatively constant during the 1988, 1990, and 1991 open-water seasons (Table 5.4; Figures 5.3-5.6). In contrast, net station SC04 had declining daily catch rates during the 1989, 1990, and 1991 open-water seasons. Daily catch rates in Simpson Cove were not found to be different during at least three of four time periods in each year of the study. At net stations KL05 (1988, 1989, and 1990), and KL10 (1988, 1990, and 1991) there were no significant differences among daily catch rates during at least three of four time periods (Table 5.5; Figures 5.7-5.10). Sampling area daily catch rates in Kaktovik Lagoon showed similar trends in 1988 and 1989. Net stations JL12 and JL14 (excluding 1990), and the Jago Lagoon sampling area all had constant daily catch rates during a minimum of three time periods (Table 5.6; Figures 5.11-5.14).

We also observed stable daily catch rates at net stations PB01 (excluding time period 3), PB02, and BL02. Net station BL04 daily catch rates were lower during the first half of the open-water season. The easternmost sampling areas, Pokok Bay (1988) and Beaufort Lagoon (1990, 1991), had stable catch rates across all time periods (Table 5.7; Figures 5.15-5.17).

Among-year comparisons for stations SC01, SC04, KL05, KL10, JL12, and JL14 indicated that 1988 daily catch rates were lower than or equal to those for 1989, 1990, and 1991 (Table 5.8; Figures 5.18-5.20). We documented similar trends for the Simpson Cove, Kaktovik and Jago lagoons sampling areas. During 1990, daily catch rates at net station BL02 were higher than those for 1991 (Table 5.8; Figure 5.21). The reverse was true at net station BL04, where 1990 daily catch rates were lower than those during 1991. Daily catch rates in Beaufort Lagoon did not differ between years.

Among-year comparisons by time period indicated trends similar to those in the among-year comparisons. Net station SC01 daily catch rates did not differ between years for time periods 1, 2, and 4 (Table 5.9; Figures 5.22, 5.23). Daily catch rates at net station SC04 did not differ between years during time periods 1 and 3. Fourhorn sculpin daily catch rates at station SC04 differed between 1990 and 1991 during time period 2, and between 1989 and 1990 during time period 4.

Station KL05 daily catch rates did not differ among three out of four years during all time periods (Table 5.10; Figures 5.24, 5.25). Daily catch rates at net station KL10 were lowest in 1988 during time periods 1 and 2. Daily catch rates did not differ for three of the four years during time periods 3 and 4. In the Kaktovik Lagoon sampling area daily catch rates did not differ for two of the four years during all time periods.

We found no differences in CPUE among years for net stations JL12, and JL14

TABLE 5.4.– Comparison of daily CPUE (fish/d) observations between time periods for fourhorn sculpin in Simpson Cove. For each net station/sampling area those time periods with the same letter, within each year, are not significantly different (Kruskal-Wallis test with Scheffé multiple comparisons). Time period 1 corresponds to the period from the first sampling day to July 31. Time period 2 corresponds to the period from August 1 to August 14. Time period 3 corresponds to the period from August 15 to August 31. Time period 4 corresponds to the period from September 1 to the last sampling day. Locations with dashed lines were not fished during that time period.

	Within year Scheffé groupings			
Time Period	1988	1989	1990	1991
	Net Station - SC01			
1	A	A,B	A	A
2	A	A	A	A
3	A	A	A	A
4	A	B	A	A
	Net Station - SC04			
1	--	A	A	A
2	--	B	A,B	A
3	--	C	B,C	B
4	--	D	C	--
	Simpson Cove			
1	A	A	A	A,B
2	A	A	A,B	A
3	A	A	B	B
4	A	B	B	B

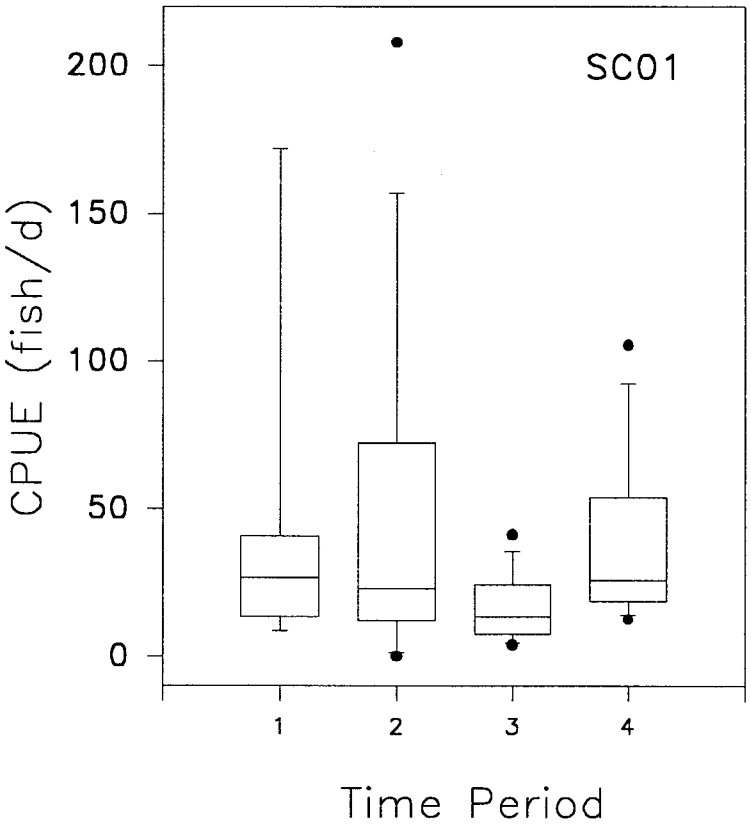

FIGURE 5.3– Boxplots comparing daily CPUE (fish/d) observations between time periods for fourhorn sculpin in Simpson Cove, 1988. 1 = the first sampling day to July 31; 2 = August 1 to 14; 3 = August 15 to 31; 4 = September 1 to the last sampling day.

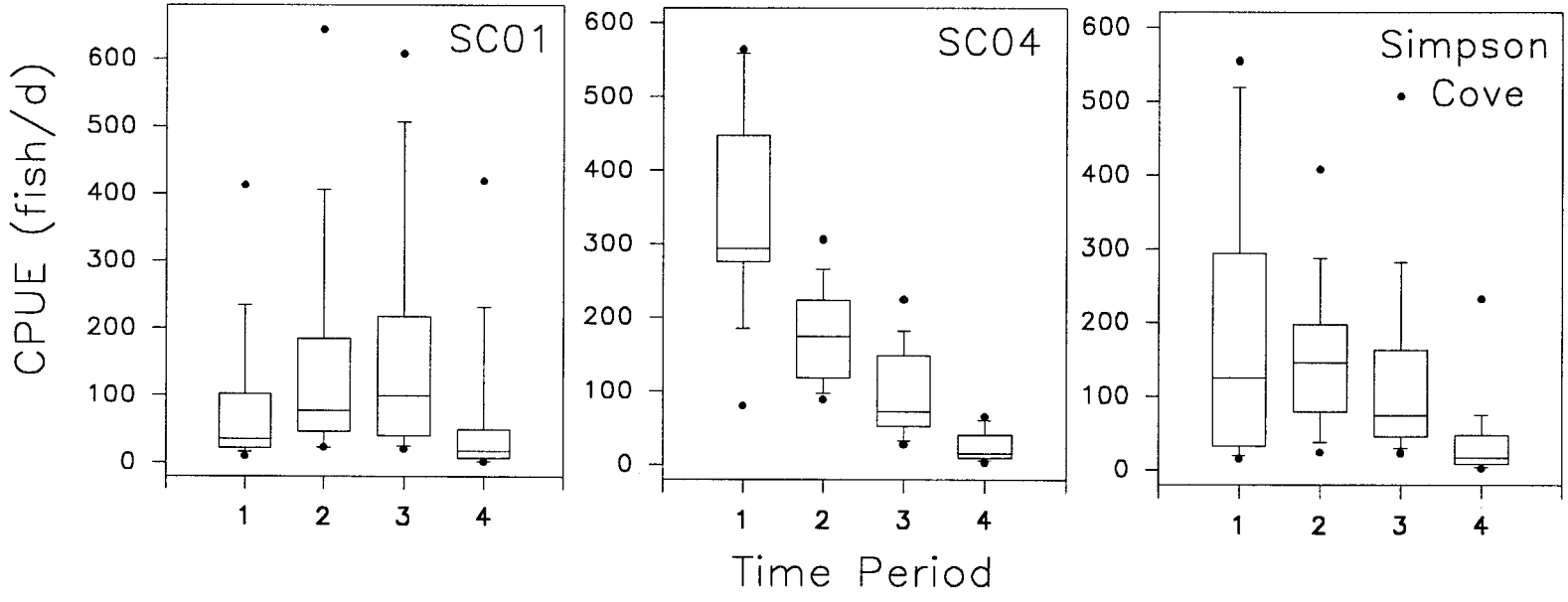

FIGURE 5.4.– Boxplots comparing daily CPUE (fish/d) observations between time periods for fourhorn sculpin in Simpson Cove, 1989. 1 = the first sampling day to July 31; 2 = August 1 to 14; 3 = August 15 to 31; 4 = September 1 to the last sampling day.

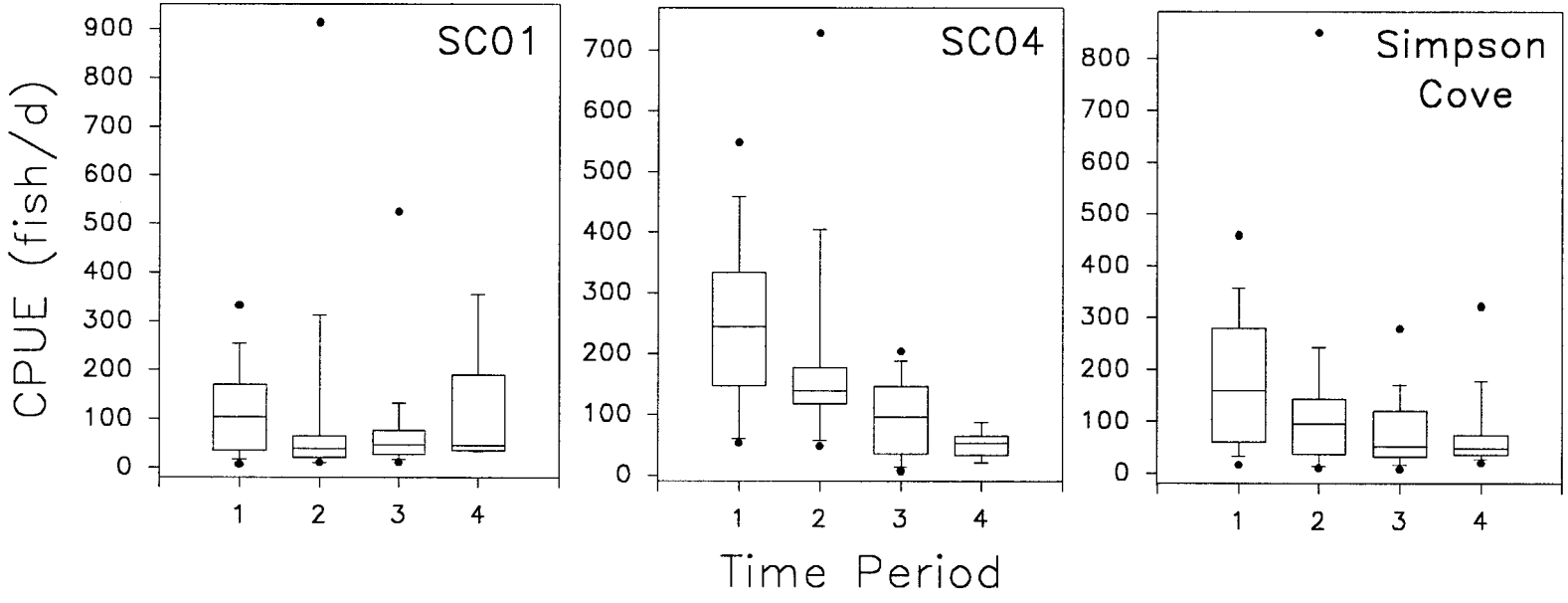

FIGURE 5.5.– Boxplots comparing daily CPUE (fish/d) observations between time periods for fourhorn sculpin in Simpson Cove in 1990. 1 = the first sampling day to July 31; 2 = August 1 to 14; 3 = August 15 to 31; 4 = September 1 to the last sampling day.

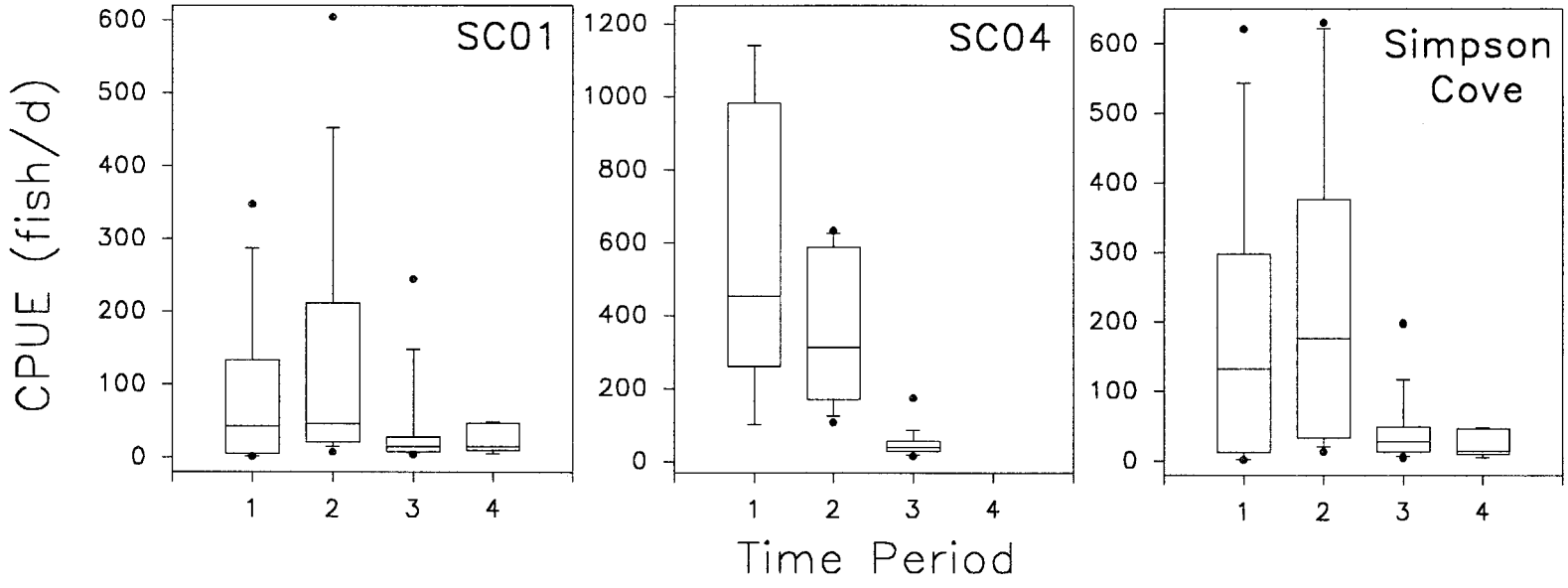

FIGURE 5.6.– Boxplots comparing daily CPUE (fish/d) observations between time periods for fourhorn sculpin in Simpson Cove in 1991. 1 = the first sampling day to July 31; 2 = August 1 to 14; 3 = August 15 to 31; 4 = September 1 to the last sampling day.

TABLE 5.5.– Comparison of daily CPUE (fish/d) observations between time periods for fourhorn sculpin in Kaktovik Lagoon, 1988-91. For each net station/sampling are those time periods with the same letter, within the same year, are not significantly different (Kruskal-Wallis test with Scheffé multiple comparisons). Time period 1 corresponds to the period from the first sampling day to July 31. Time period 2 corresponds to the period from August 1 to August 14. Time period 3 corresponds to the period from August 15 to August 31. Time period 4 corresponds to the period from September 1 to the last sampling day.

	Within year Scheffé groupings			
Time Period	1988	1989	1990	1991
	Net Station - KL05			
1	A,B	A	B	A
2	B	A	B	A
3	B	A	A	A
4	A	A	A	A
	Net Station - KL10			
1	B	B	B	A
2	B	B	B	B
3	A,B	A	A,B	A,B
4	A	A	A	A
	Kaktovik Lagoon			
1	B	A,B	B,C	A
2	B	B	C	B
3	B	A	A,B	B
4	A	A,B	A	A

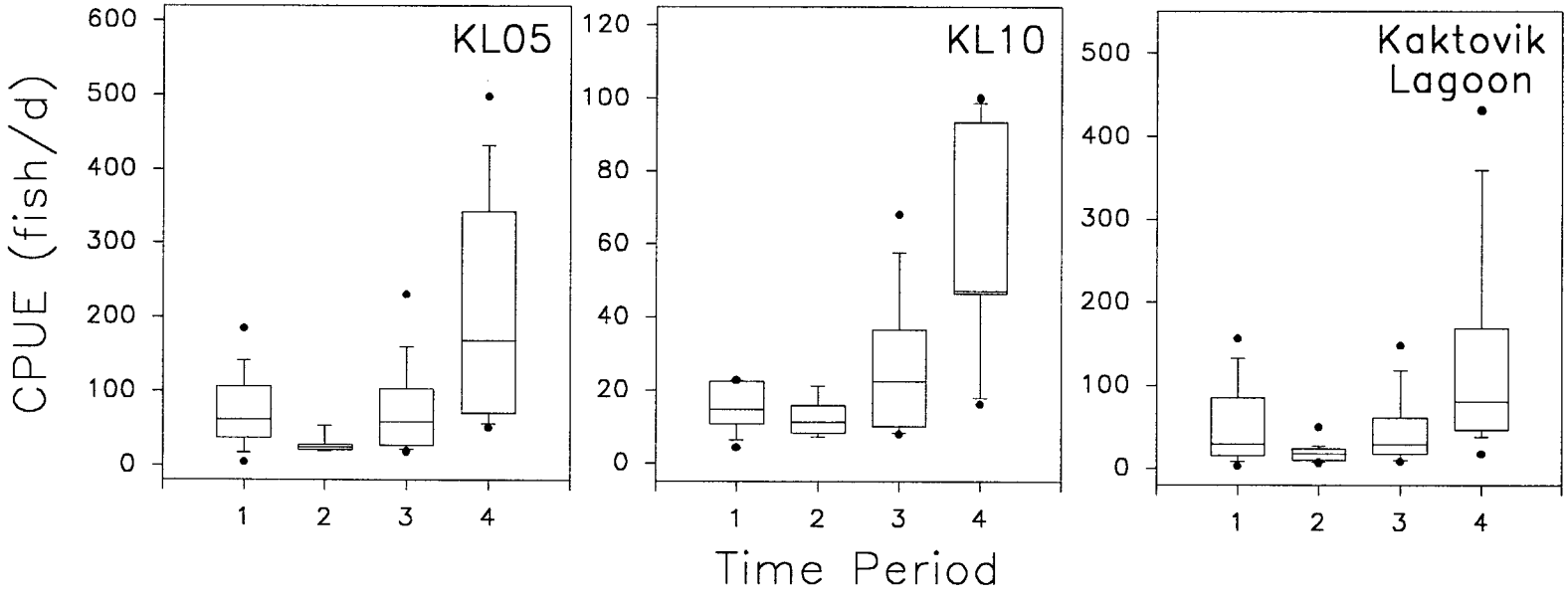

FIGURE 5.7.– Boxplots comparing daily CPUE (fish/d) observations between time periods for fourhorn sculpin in Kaktovik Lagoon in 1988. 1 = the first sampling day to July 31; 2 = August 1 to 14; 3 = August 15 to 31; 4 = September 1 to the last sampling day.

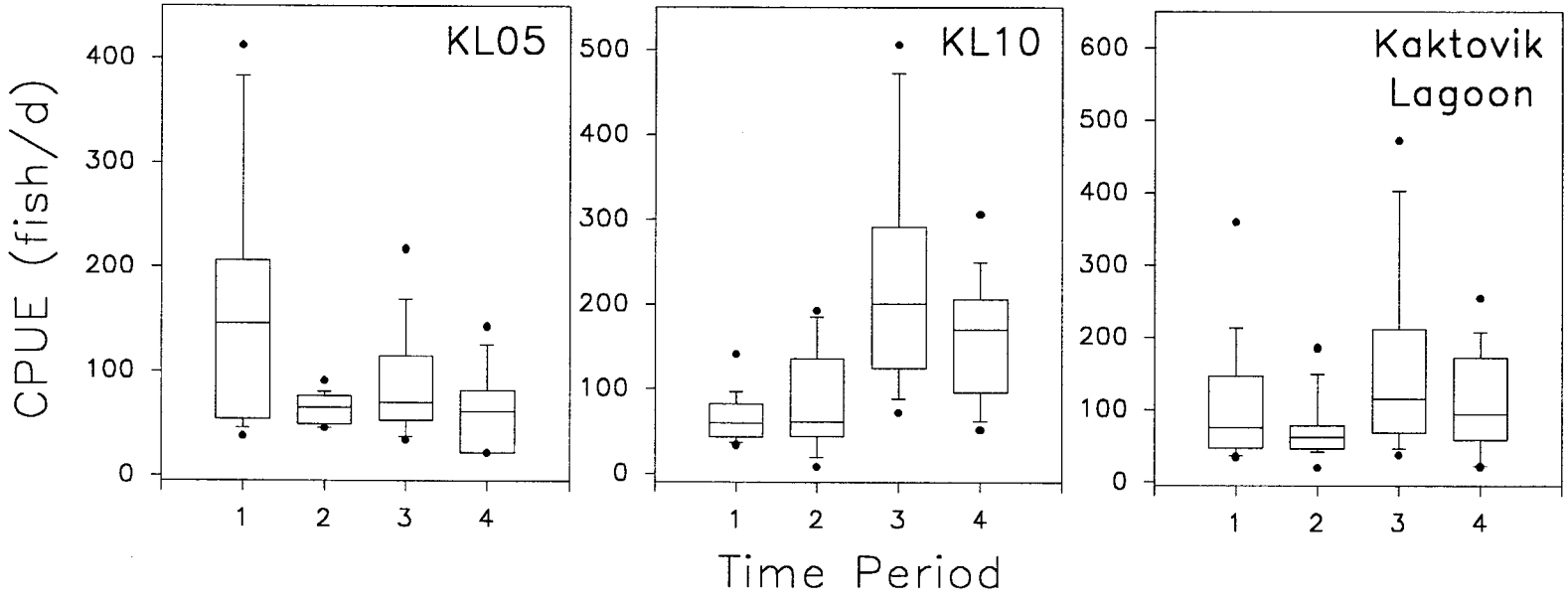

FIGURE 5.8.– Boxplots comparing daily CPUE (fish/d) observations between time periods for fourhorn sculpin in Kaktovik Lagoon in 1989. 1 = the first sampling day to July 31; 2 = August 1 to 14; 3 = August 15 to 31; 4 = September 1 to the last sampling day.

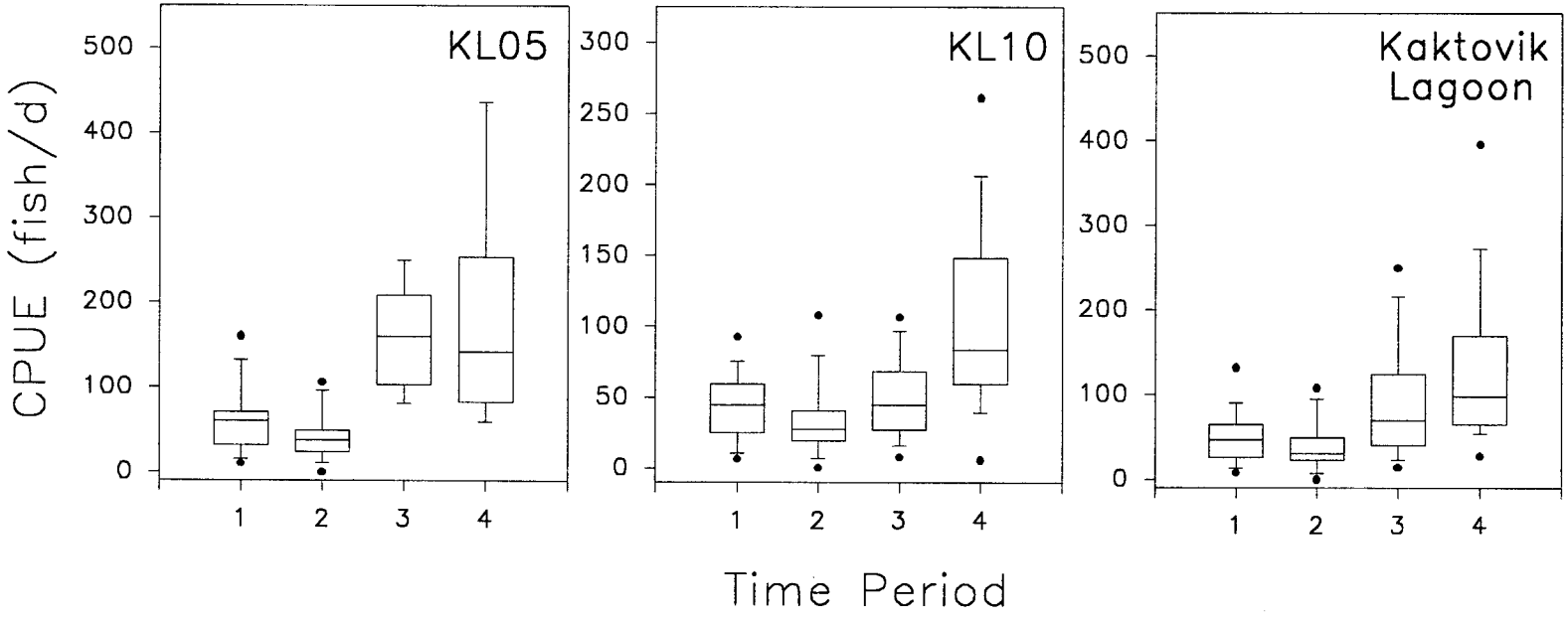

FIGURE 5.9.– Boxplots comparing daily CPUE (fish/d) observations between time periods for fourhorn sculpin in Kaktovik Lagoon in 1990. 1 = the first sampling day to July 31; 2 = August 1 to 14; 3 = August 15 to 31; 4 = September 1 to the last sampling day.

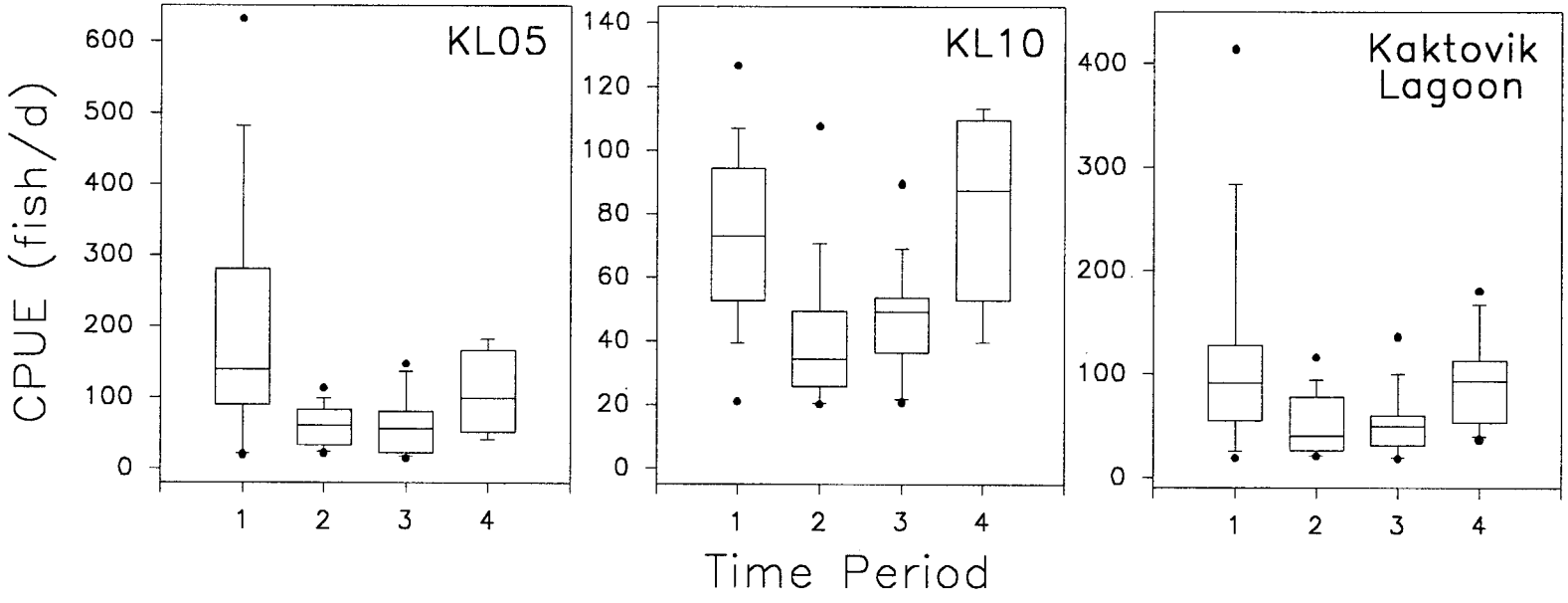

FIGURE 5.10.– Boxplots comparing daily CPUE (fish/d) observations between time periods for fourhorn sculpin in Kaktovik Lagoon in 1991. 1 = the first sampling day to July 31; 2 = August 1 to 14; 3 = August 15 to 31; 4 = September 1 to the last sampling day.

TABLE 5.6.– Comparison of daily CPUE (fish/d) observations between time periods for fourhorn sculpin in Jago Lagoon, 1988-91. For each net station/sampling area those time periods with the same letter, within the same year, are not significantly different (Kruskal-Wallis test with Scheffé multiple comparisons). Time period 1 corresponds to the period from the first sampling day to July 31. Time period 2 corresponds to the period from August 1 to August 14. Time period 3 corresponds to the period from August 15 to August 31. Time period 4 corresponds to the period from September 1 to the last sampling day.

	Within year Scheffé groupings			
Time Period	1988	1989	1990	1991
	Net Station - JL12			
1	B	A	A	A
2	B	A	A	A
3	A,B	A	A	A
4	A	A	A	A
	Net Station - JL14			
1	A,B	A	A	A
2	B	A,B	A,B	A,B
3	A,B	A	B,C	B
4	A	B	C	B
	Jago Lagoon			
1	B	A,B	A	A
2	B	A	A,B	A,B
3	A,B	A	A,B	B
4	A	B	B	B

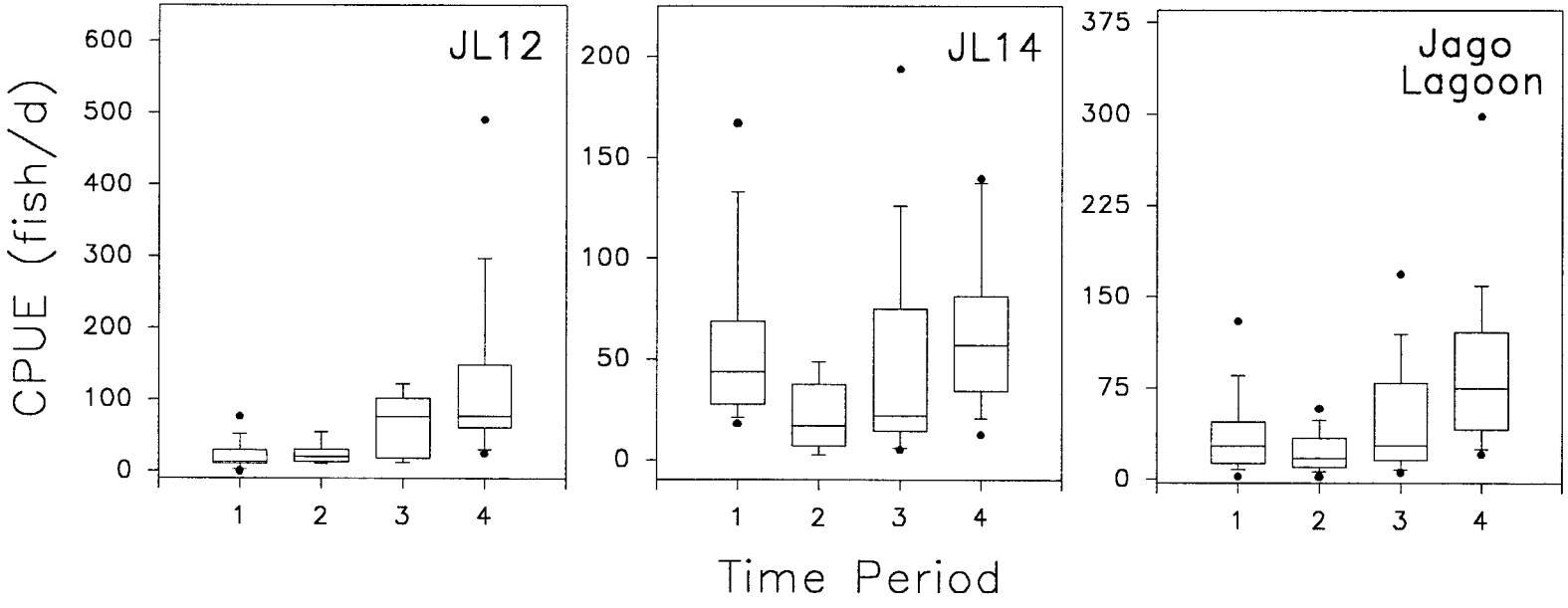

FIGURE 5.11.– Boxplots comparing daily CPUE (fish/d) observations between time periods for fourhorn sculpin in Jago Lagoon in 1988. 1 = the first sampling day to July 31; 2 = August 1 to 14; 3 = August 15 to 31; 4 = September 1 to the last sampling day.

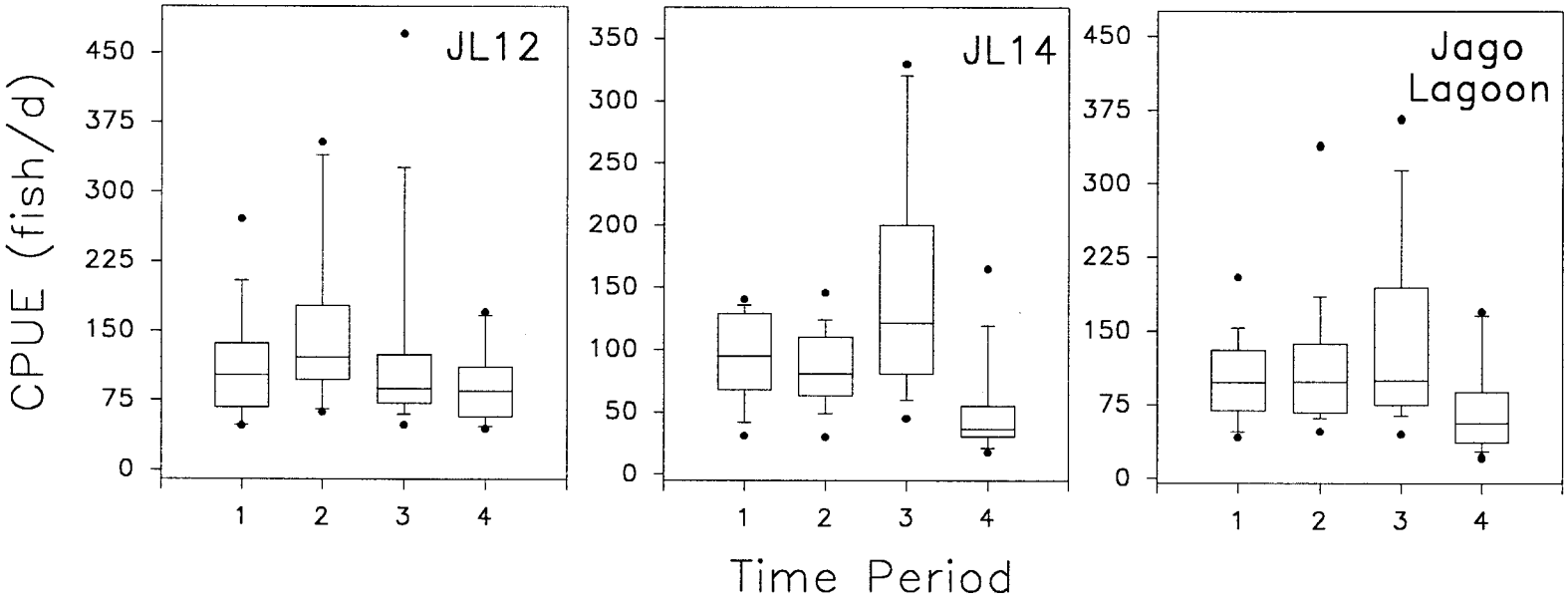

FIGURE 5.12.– Boxplots comparing daily CPUE (fish/d) observations between time periods for fourhorn sculpin in Jago Lagoon in 1989. 1 = the first sampling day to July 31; 2 = August 1 to 14; 3 = August 15 to 31; 4 = September 1 to the last sampling day.

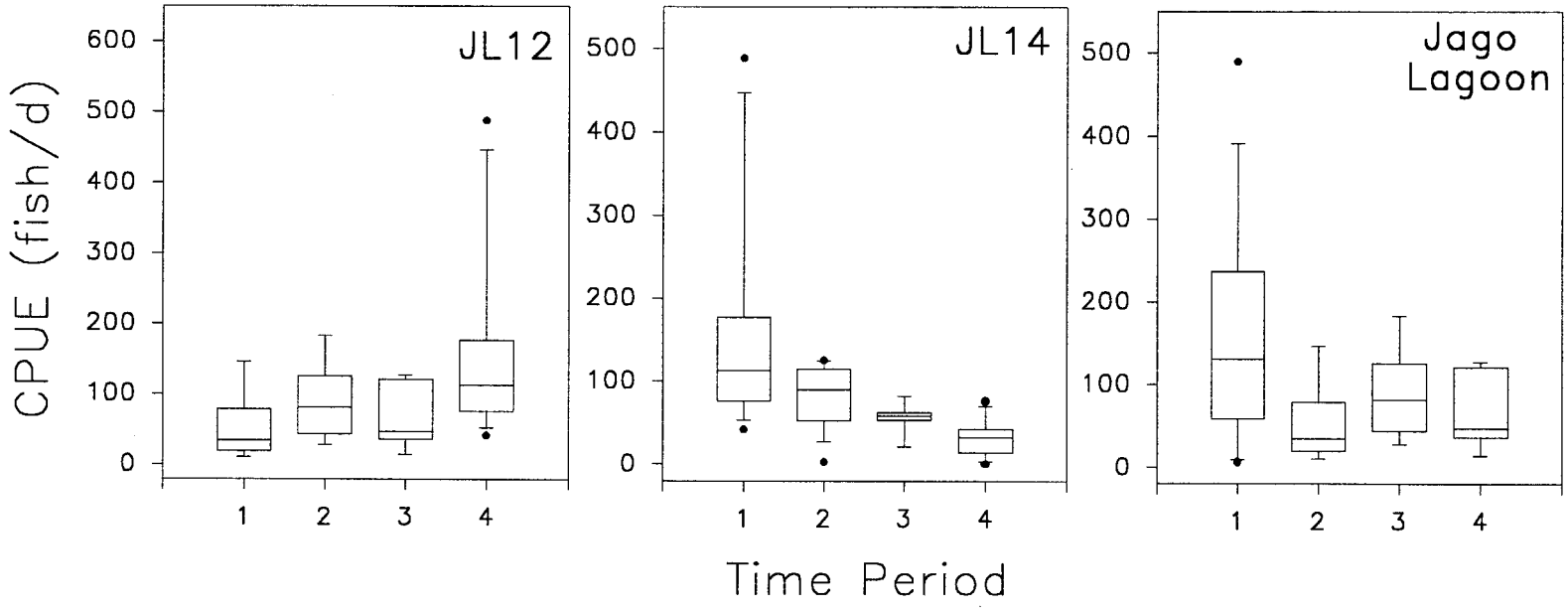

FIGURE 5.13.– Boxplots comparing daily CPUE (fish/d) observations between time periods for fourhorn sculpin in Jago Lagoon in 1990. 1 = the first sampling day to July 31; 2 = August 1 to 14; 3 = August 15 to 31; 4 = September 1 to the last sampling day.

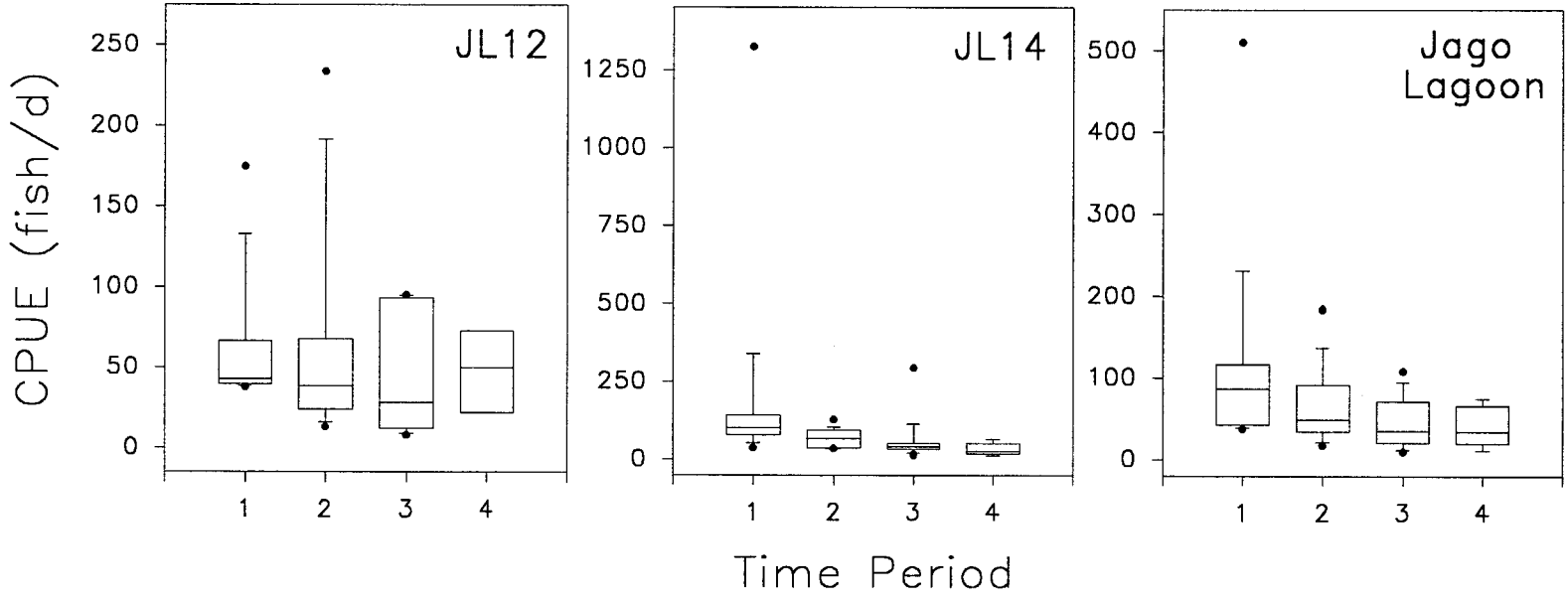

FIGURE 5.14.– Boxplots comparing daily CPUE (fish/d) observations between time periods for fourhorn sculpin in Jago Lagoon in 1991. 1 = the first sampling day to July 31; 2 = August 1 to 14; 3 = August 15 to 31; 4 = September 1 to the last sampling day.

TABLE 5.7.– Comparison of daily CPUE (fish/d) observations between time periods for fourhorn sculpin in Pokok Bay/Beaufort Lagoon, 1988-91. For each net station/sampling area those time periods with the same letter, within the same year, are not significantly different (Kruskal-Wallis test with Scheffé multiple comparisons). Time period 1 corresponds to the period from the first sampling day to July 31. Time period 2 corresponds to the period from August 1 to August 14. Time period 3 corresponds to the period from August 15 to August 31. Time period 4 corresponds to the period from September 1 to the last sampling day. Locations with dashed lines were not fished during that time period.

	Within year Scheffé groupings		
Time Period	1988	1990	1991
	PB01	**BL02**	
1	A	A	A
2	A	A	A
3	B	A	A
4	A	A	A
	PB02	**BL04**	
1	--	B	C
2	A	B	B,C
3	A	A	A
4	A	A	B
	Pokok Bay	**Beaufort Lagoon**	
1	A	A	A
2	A	A	A
3	A	A	A
4	A	A	A

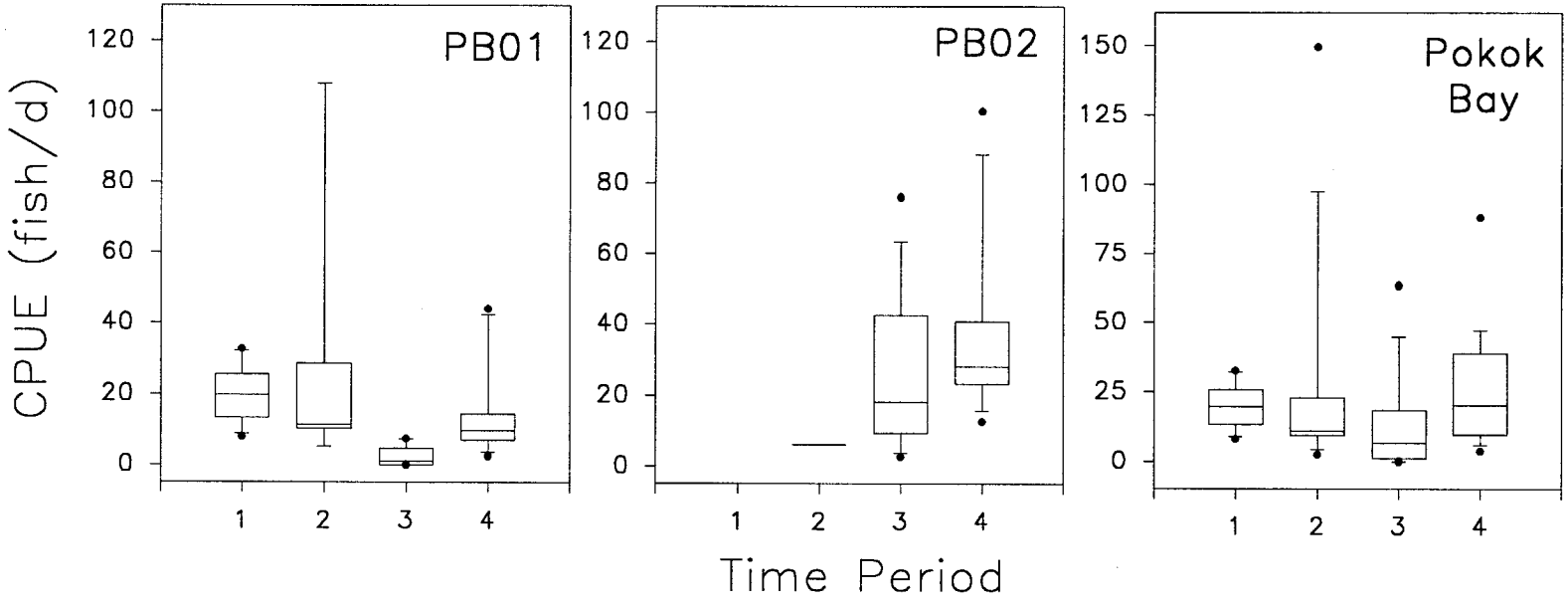

FIGURE 5.15.– Boxplots comparing daily CPUE (fish/d) observations between time periods for fourhorn sculpin in Pokok Bay in 1988. 1 = the first sampling day to July 31; 2 = August 1 to 14; 3 = August 15 to 31; 4 = September 1 to the last sampling day.

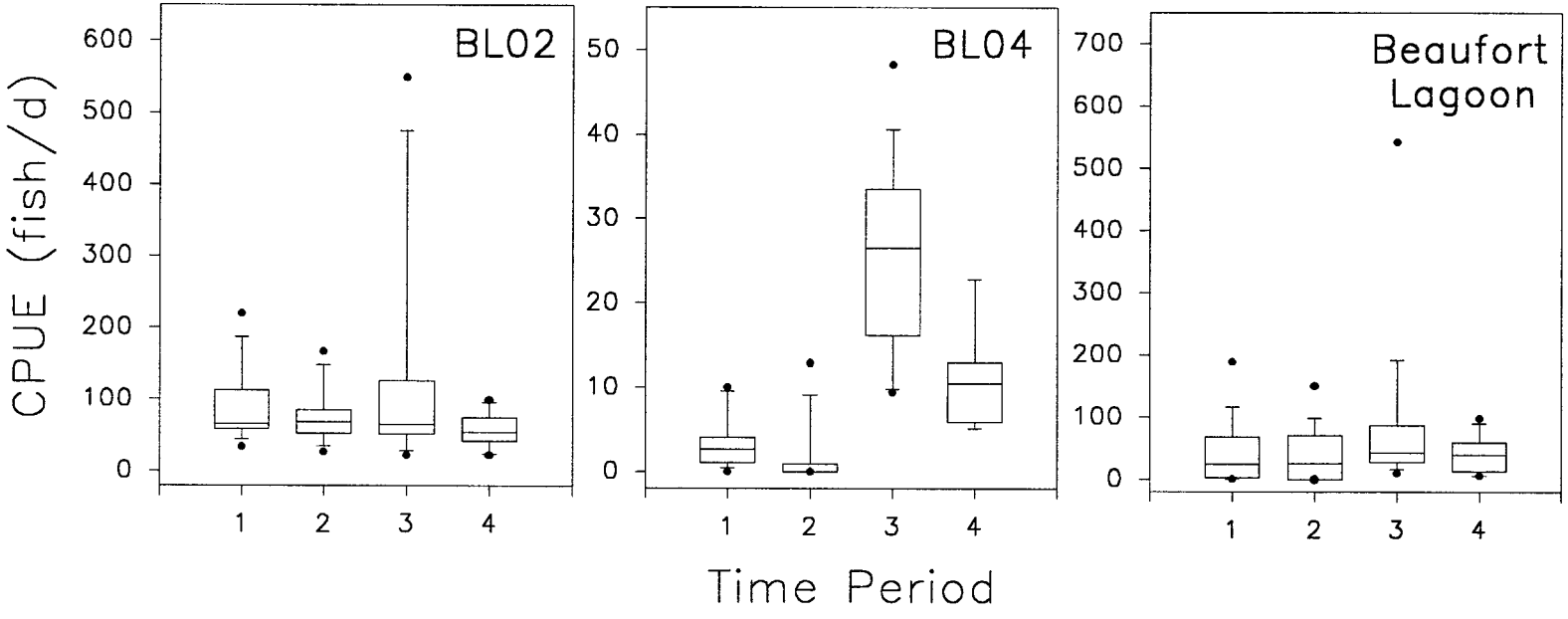

FIGURE 5.16.– Boxplots comparing daily CPUE (fish/d) observations between time periods for fourhorn sculpin in Beaufort Lagoon in 1990. 1 = the first sampling day to July 31; 2 = August 1 to 14; 3 = August 15 to 31; 4 = September 1 to the last sampling day.

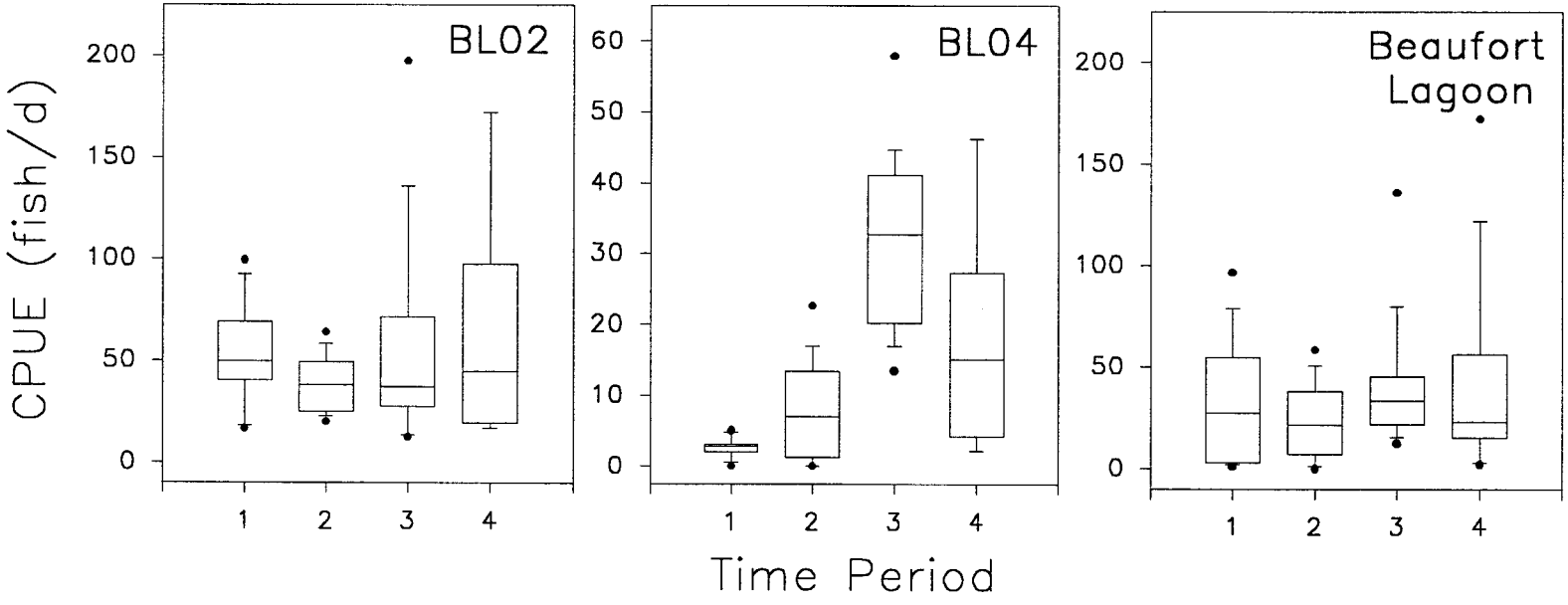

FIGURE 5.17.– Boxplots comparing daily CPUE (fish/d) observations between time periods for fourhorn sculpin in Beaufort Lagoon in 1991. 1 = the first sampling day to July 31; 2 = August 1 to 14; 3 = August 15 to 31; 4 = September 1 to the last sampling day.

TABLE 5.8.– Comparison of daily CPUE (fish/d) observations between years for fourhorn sculpin. For each net station/sampling area those years with the same letter are not significantly different (Kruskal-Wallis test with Scheffé multiple comparisons). Locations with dashed lines were not fished during that year.

Year	Within location Scheffé groupings		
	Net Station	Net Station	Sampling Area
	SC01	**SC04**	**Simpson Cove**
1988	B	--	B
1989	A	A	A
1990	A	A	A
1991	B	A	A
	KL05	**KL10**	**Kaktovik Lagoon**
1988	A	C	C
1989	A	A	A
1990	A	B	B,C
1991	A	B	B
	JL12	**JL14**	**Jago Lagoon**
1988	B	B	B
1989	A	A	A
1990	A	A	A
1991	B	A	B
	BL02	**BL04**	**Beaufort Lagoon**
1990	A	B	A
1991	B	A	A

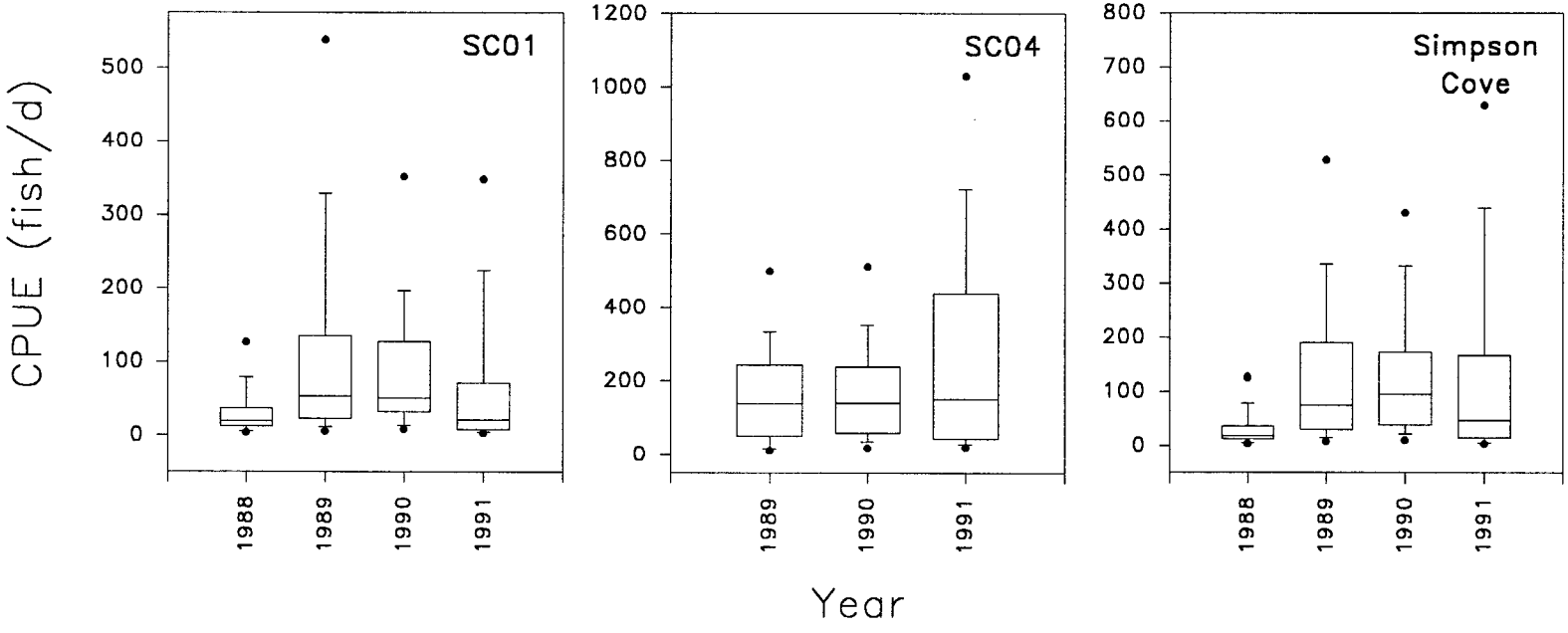

FIGURE 5.18.— Boxplots comparing daily CPUE (fish/d) observations between years for fourhorn sculpin in Simpson Cove.

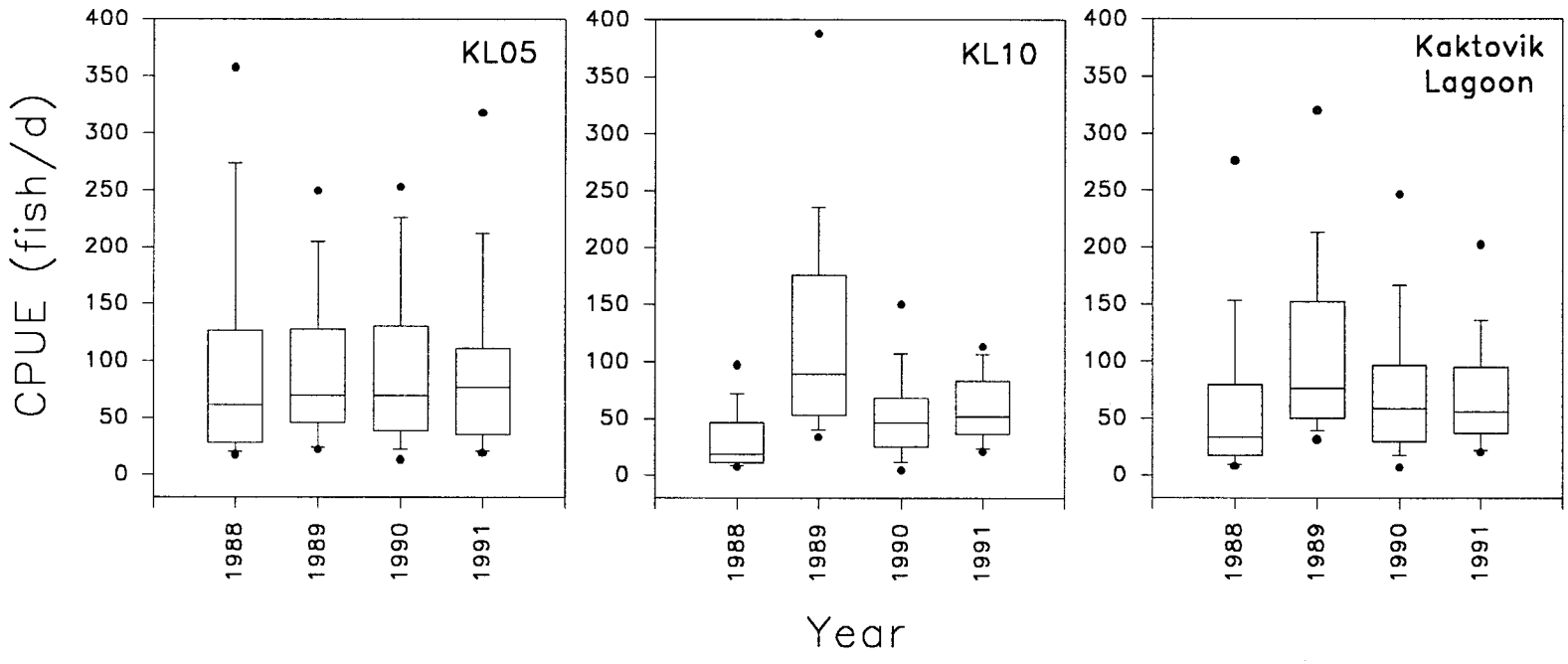

FIGURE 5.19.— Boxplots comparing daily CPUE (fish/d) observations between years for fourhorn sculpin in Kaktovik Lagoon.

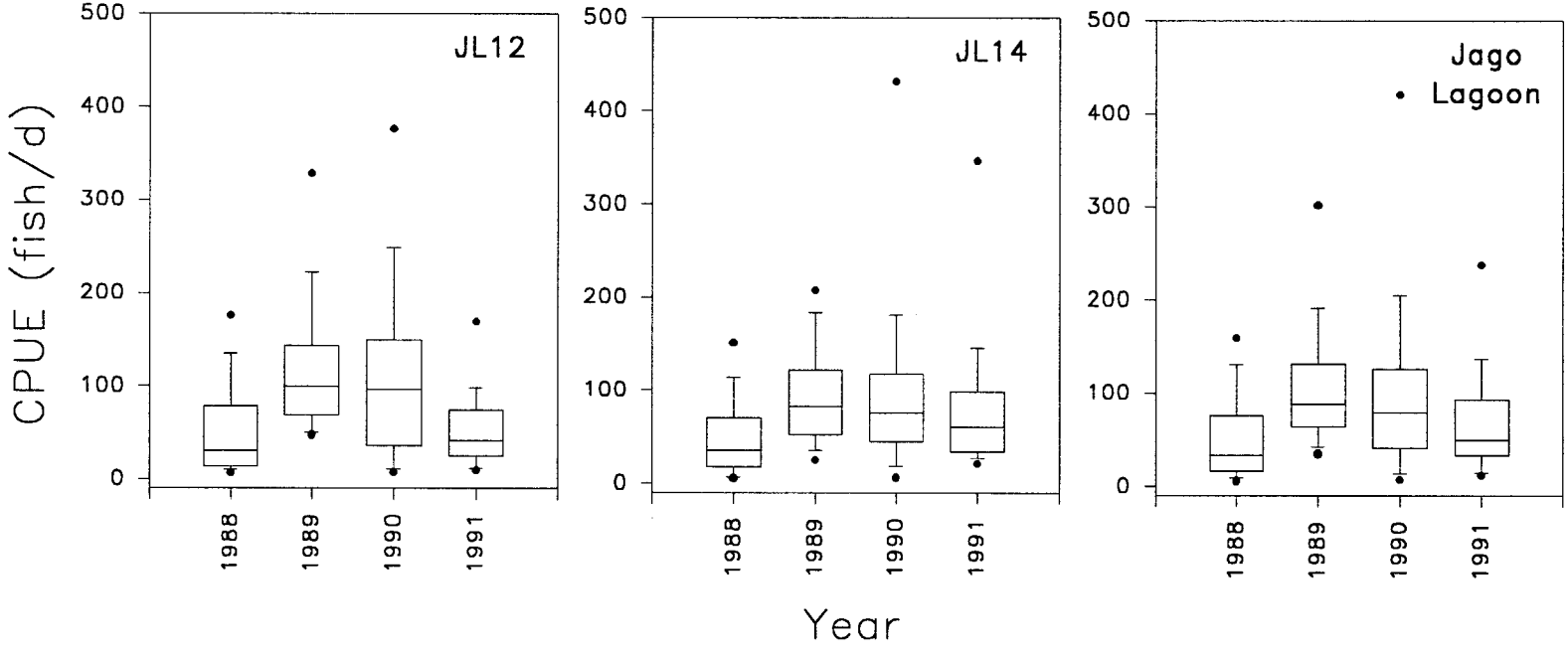

FIGURE 5.20.– Boxplots comparing daily CPUE (fish/d) observations between years for fourhorn sculpin in Jago Lagoon.

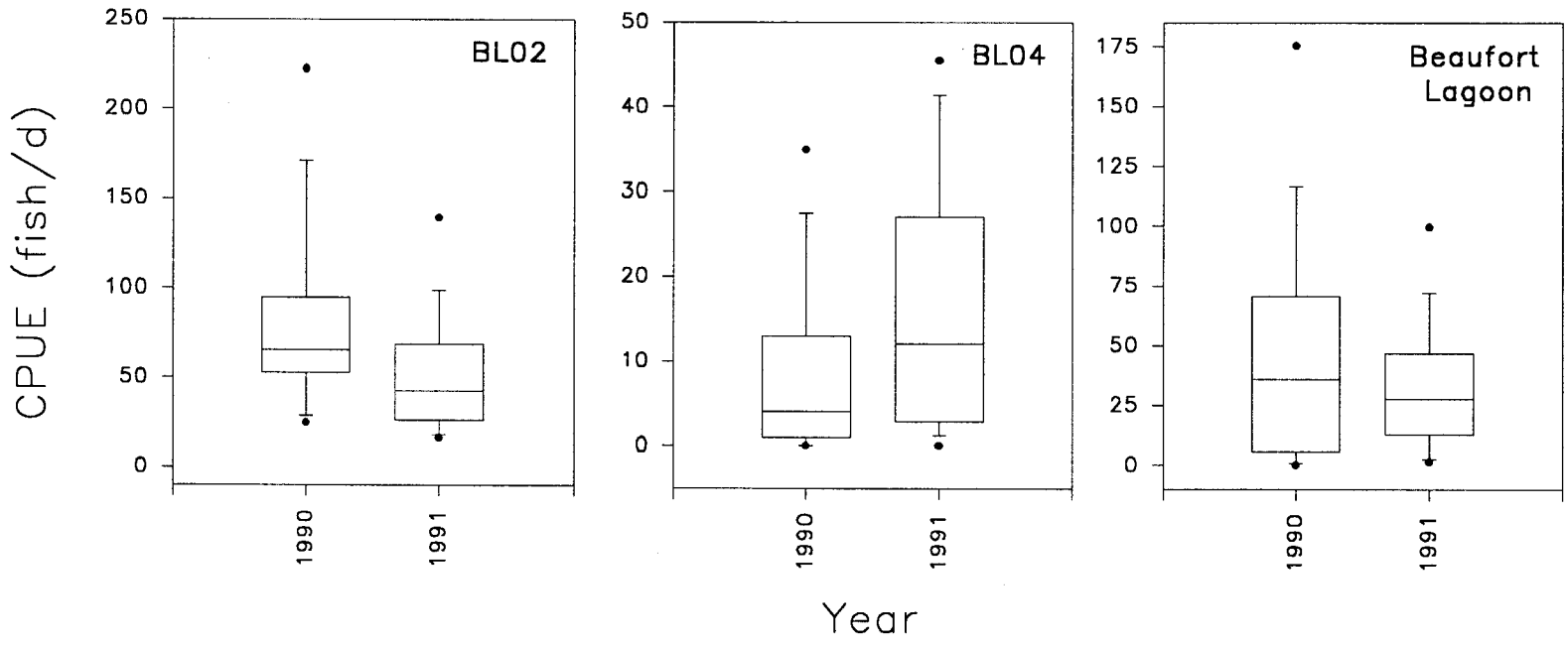

FIGURE 5.21.– Boxplots comparing daily CPUE (fish/d) observations between years for fourhorn sculpin in Beaufort Lagoon.

TABLE 5.9.– Comparison of daily CPUE (fish/d) observations between years for fourhorn sculpin in Simpson Cove. For each net station/sampling area those years with the same letter, within the time period, are not significantly different (Kruskal-Wallis test with Scheffé multiple comparisons). Locations with dashed lines were not sampled during that year.

	Within location Scheffé groupings		
Year	SC01	SC04	Simpson Cove
Time Period 1 - first day to July 31			
1988	A	--	B
1989	A	A	A
1990	A	A	A
1991	A	A	A,B
Time Period 2 - August 1 to August 14			
1988	A	--	B
1989	A	A,B	A
1990	A	B	A,B
1991	A	A	A
Time Period 3 - August 15 to August 31			
1988	B	--	B
1989	A	A	A
1990	A	A	A
1991	B	A	B
Time Period 4 - September 1 to last day			
1988	A	--	A,B
1989	A	B	A,B
1990	A	A	A
1991	A	--	B

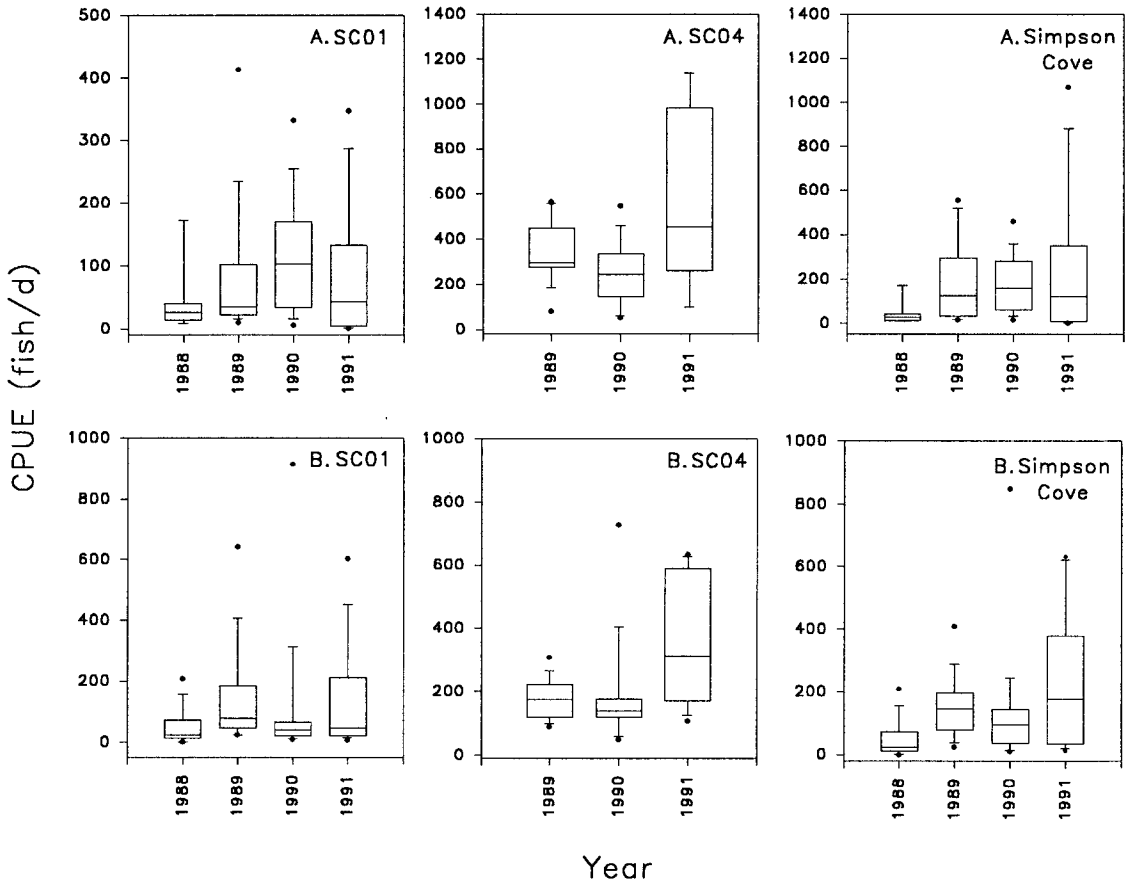

FIGURE 5.22.– Boxplots comparing daily CPUE (fish/d) observations between years for fourhorn sculpin in Simpson Cove. A = time period 1, the first sampling day to July 31. B = time period 2, August 1 to August 14.

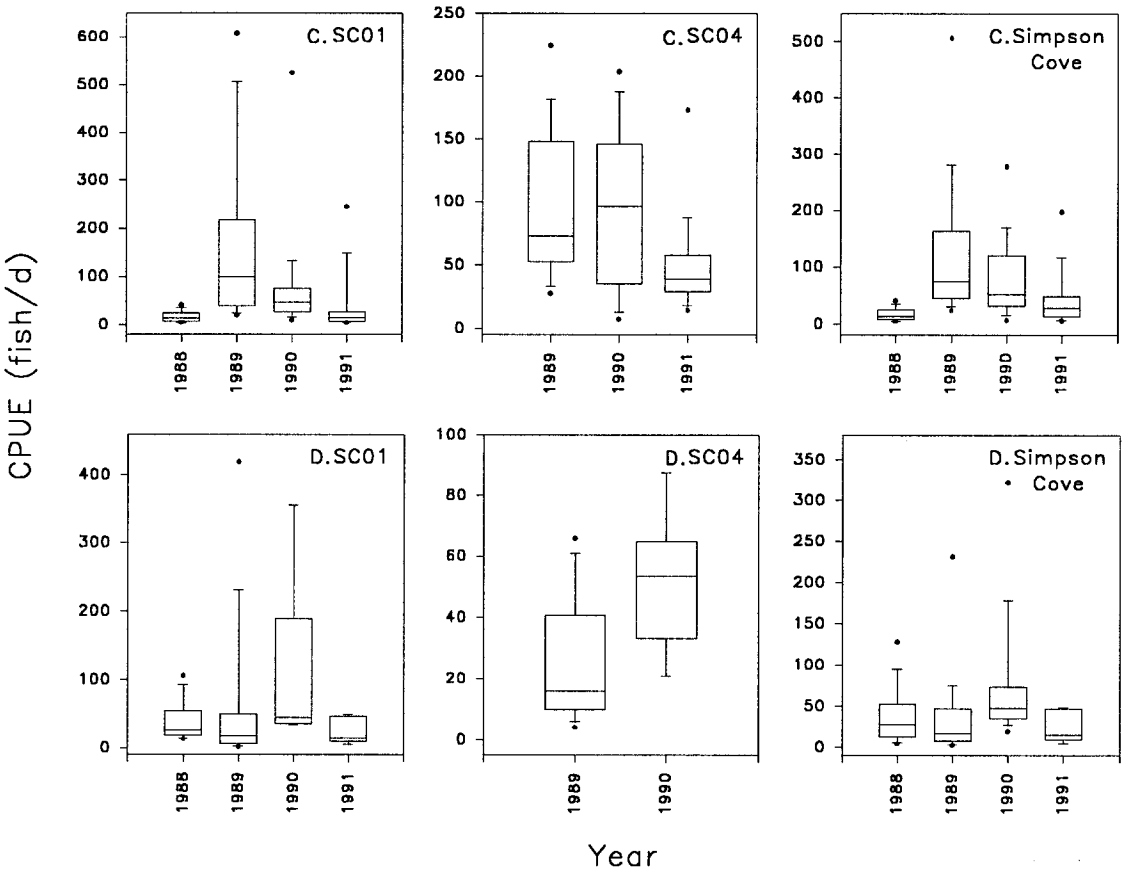

FIGURE 5.23.– Boxplots comparing daily CPUE (fish/d) observations between years for fourhorn sculpin in Simpson Cove. C = time period 3, August 15 to August 31. D = time period 4, September 1 to the last sampling day.

TABLE 5.10.– Comparison of daily CPUE (fish/d) observations between years for fourhorn sculpin in Kaktovik Lagoon. For each net station/sampling area those years with the same letter, within the time period, are not significantly different (Kruskal-Wallis test with Scheffé multiple comparisons).

	Within location Scheffé groupings		
Year	KL05	KL10	Kaktovik Lagoon
Time Period 1 - first day to July 31			
1988	A,B	C	B
1989	A	A,B	A
1990	B	B	B
1991	A	A	A
Time Period 2 - August 1 to August 14			
1988	B	B	C
1989	A	A	A
1990	A,B	A	B
1991	A	A	A,B
Time Period 3 - August 15 to August 31			
1988	B	B	C
1989	A,B	A	A
1990	A	B	A,B
1991	B	B	B,C
Time Period 4 - September 1 to last day			
1988	A	B	A
1989	A	A	A
1990	A	A,B	A
1991	A	A,B	A

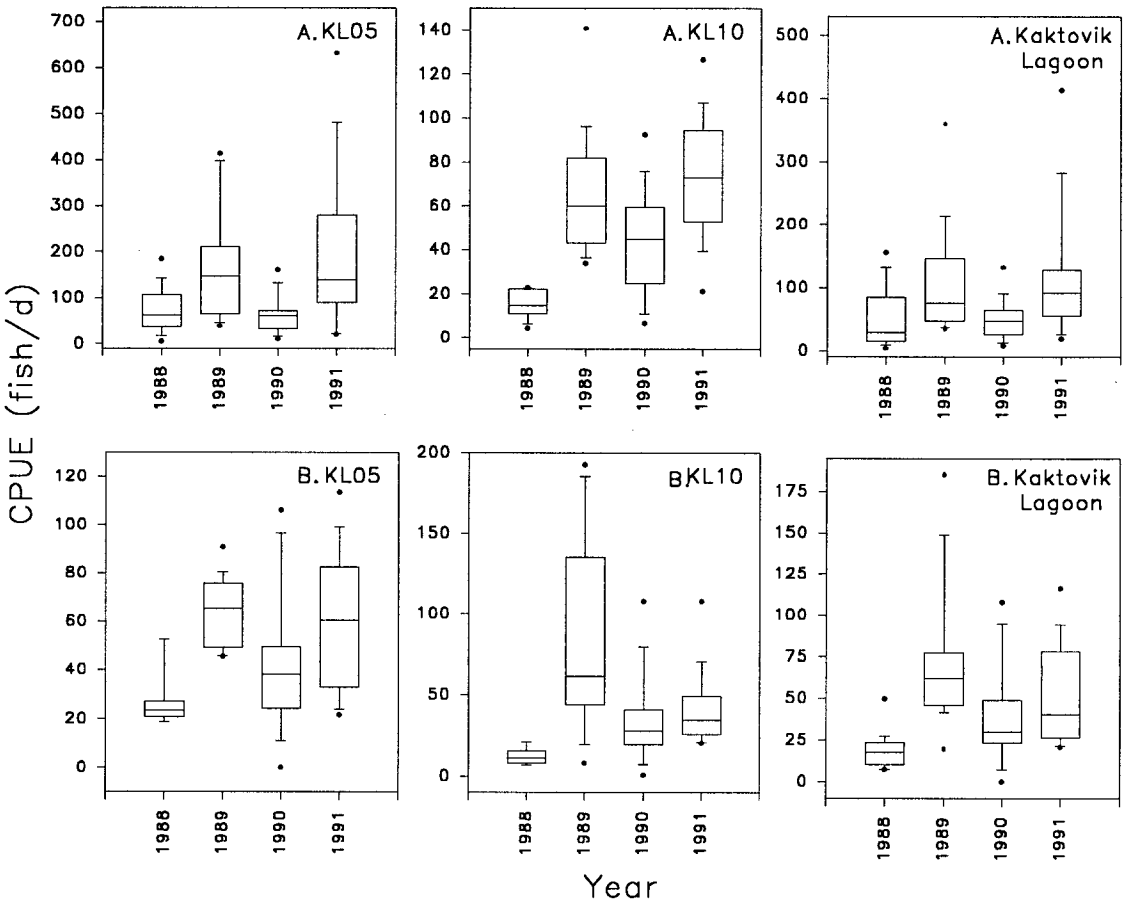

FIGURE 5.24.– Boxplots comparing daily CPUE (fish/d) observations between years for fourhorn sculpin in Kaktovik Lagoon. A = time period 1, the first sampling day to July 31. B = time period 2, August 1 to August 14.

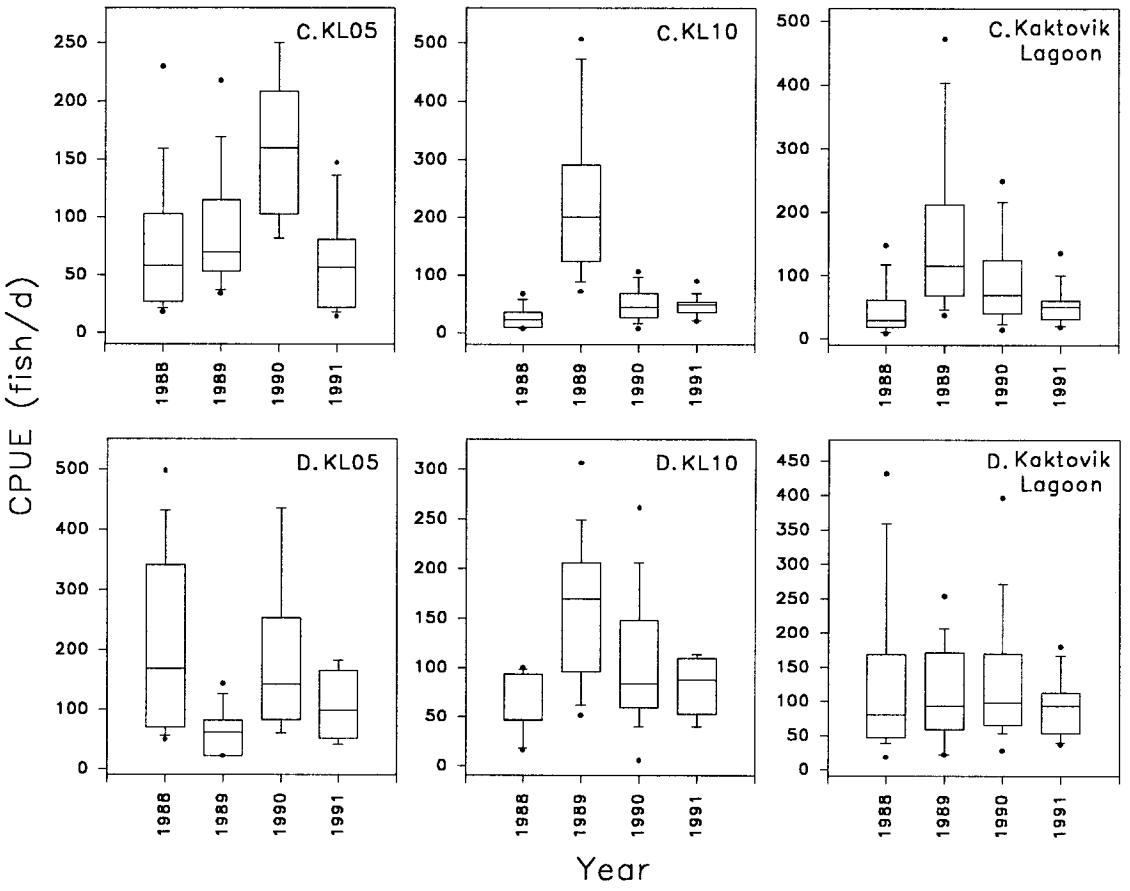

FIGURE 5.25.– Boxplots comparing daily CPUE (fish/d) observations between years for fourhorn sculpin in Kaktovik Lagoon. C = time period 3, August 15 to August 31. D = time period 4, September 1 to the last sampling day.

for at least three of the four years for all time periods (Table 5.11; Figures 5.26, 5.27). The Jago Lagoon sampling area had its lowest daily catch rates in 1988 during time periods 1 and 2. Jago Lagoon daily catch rates during time periods 3 and 4 did not differ among at least three of the four years. During time periods 1 and 2 net station BL02 daily catch rates were higher in 1990 (Table 5.12; Figures 5.28, 5.29). At net stations BL02 and BL04 no differences between 1990 and 1991 daily catch rates occurred during time periods 3 and 4. Beaufort Lagoon daily catch rates did not differ between 1990 and 1991.

Length Frequency Distributions

Fourhorn sculpin length frequency distributions indicated bi- and trimodal distributions when stratified by area, year, and time period (Figures 5.30-5.38). The strength of the modes varied among time periods and years. The first mode generally occurred at 50-100 mm TL, the second at 100-150 mm TL, and the third occurred between 150 and 200 mm TL.

In Simpson Cove, length frequency distributions indicated a general pattern of three modes during the first two time periods (July 9 to August 15) except in 1991 when a bimodal pattern appeared (Figure 5.30). During the third and fourth periods (August 16 to September 14), the distributions showed a bimodal pattern except in 1988 during the third period, August 16 to August 30 (Figure 5.31). The mode representing the largest fish diminished by the end of sampling for each year.

In Kaktovik and Jago lagoons, the length frequency distributions indicated trimodal patterns throughout all time periods (Figures 5.32-5.35). Some of the peaks comprised a very small proportion of the catch (Figures 5.32C; 5.34C, F, G; 5.35B, C, D). In these two areas, the mode representing the largest fish did not diminish by the end of sampling for each year.

In Pokok Lagoon for 1988, the modes indicated a strong proportion of 50-100 mm TL sculpin in each of the periods (Figure 5.36). The second and third length frequency modes were not obvious during the four sampling periods, except in the last sampling period in which the distribution appeared to be trimodal (Figure 5.36D), and weak modes appeared during the first and second sampling periods (Figure 5.36A, B).

In Beaufort Lagoon, the length frequency distributions were distinct for fourhorn sculpin between 50 and 100 mm TL except in 1990 during the last sampling period (Figures 5.37, 5.38E). The trends in distribution were generally bimodal, although the second modes (100-150 mm TL) were sometimes weak (Figures 5.37B, D, F; and 5.38A, C, F). Modes in the third distribution (150-200 mm TL) appeared during the third and fourth sampling periods in 1989, 1990 and 1991 (Figure 5.38).

Condition

Gender differences.— Significant differences in slope ($P = 0.003$) precluded statements about condition between female and male fourhorn sculpin when data were pooled over all years (Table 5.13). Similar results were obtained when data were analyzed without outliers. Plots of transformed data (Figure 5.39A,

TABLE 5.11.– Comparison of daily CPUE (fish/d) observations between years for fourhorn sculpin cod in Jago Lagoon. For each net station/sampling area those years with the same letter, within the time period, are not significantly different (Kruskal-Wallis test with Scheffé multiple comparisons).

	Within location Scheffé groupings		
Year	JL12	JL14	Jago Lagoon
Time Period 1 - first day to July 31			
1988	B	B	B
1989	A	A,B	A
1990	A	A	A
1991	A,B	A	A
Time Period 2 - August 1 to August 14			
1988	B	B	C
1989	A	A	A
1990	B	A	A,B
1991	B	A	B
Time Period 3 - August 15 to August 31			
1988	A	B	B
1989	A	A	A
1990	A	A,B	A,B
1991	A	B	B
Time Period 4 - September 1 to last day			
1988	A	A	A
1989	A	A	A
1990	A	A	A
1991	A	A	A

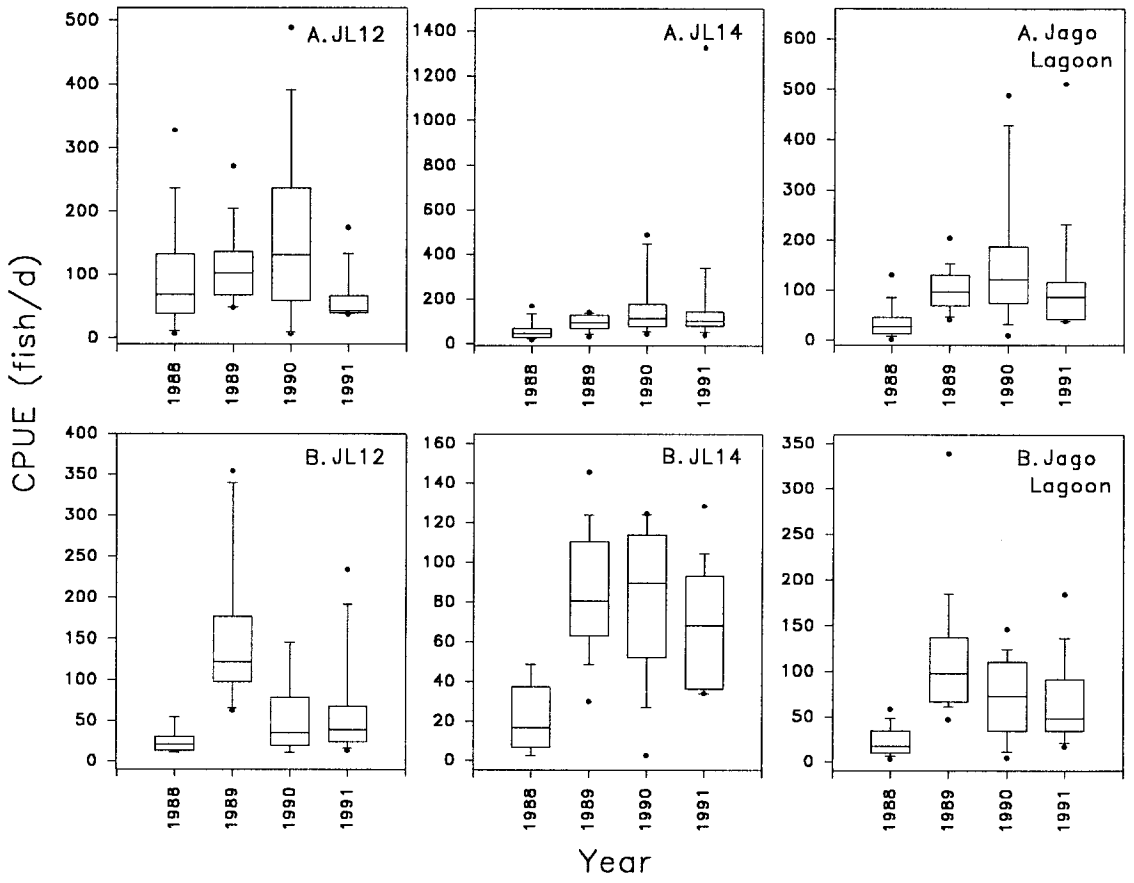

FIGURE 5.26.– Boxplots comparing daily CPUE (fish/d) observations between years for fourhorn sculpin in Jago Lagoon. A = time period 1, the first sampling day to July 31. B = time period 2, August 1 to August 14.

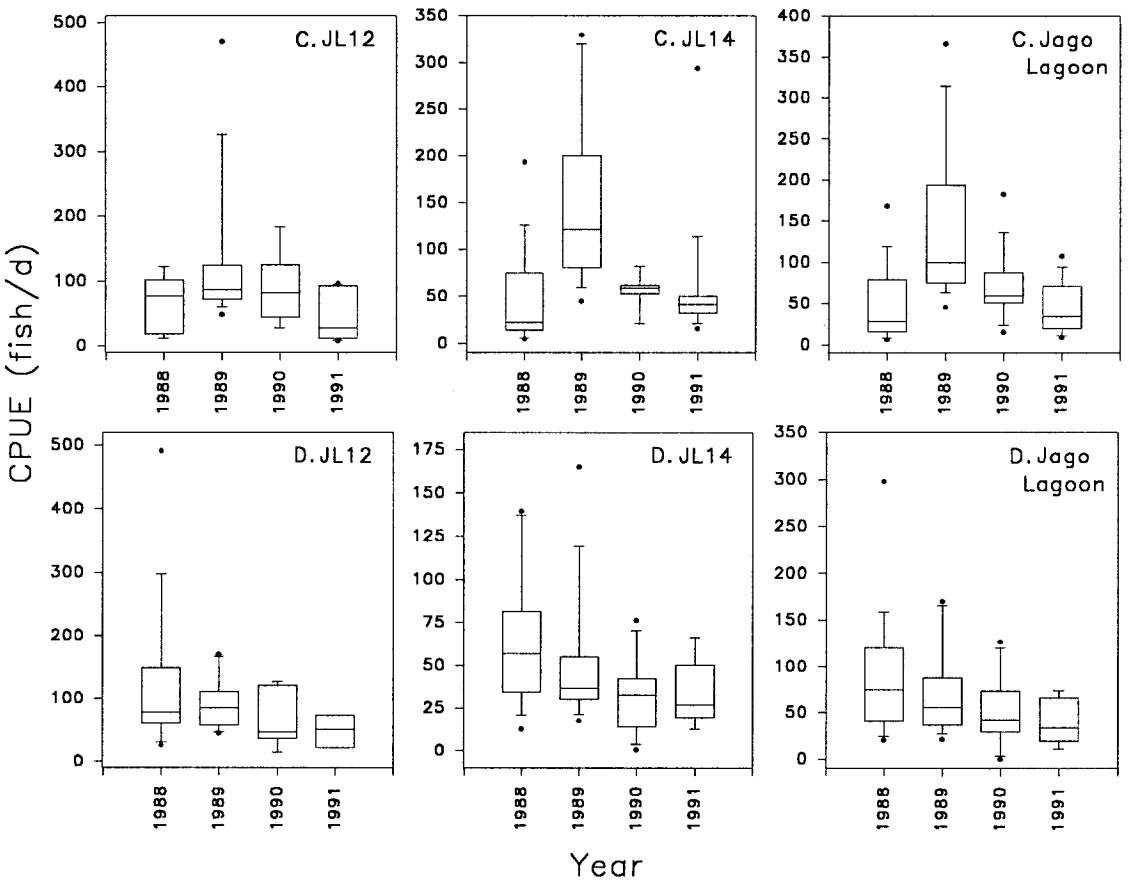

FIGURE 5.27.– Boxplots comparing daily CPUE (fish/d) observations between years for fourhorn sculpin in Jago Lagoon. C = time period 3, August 15 to August 31. D = time period 4, September 1 to the last sampling day.

TABLE 5.12.– Comparison of daily CPUE (fish/d) observations between years for fourhorn sculpin in Beaufort Lagoon. For each net station/sampling area those years with the same letter, within the time period, are not significantly different (Kruskal-Wallis test with Scheffé multiple comparisons).

	Within location Scheffé groupings		
Year	BL02	BL04	Beaufort Lagoon
Time Period 1 - first day to July 31			
1990	A	A	A
1991	B	A	A
Time Period 2 - August 1 to August 14			
1990	A	B	A
1991	B	A	A
Time Period 3 - August 15 to August 31			
1990	A	A	A
1991	A	A	A
Time Period 4 - September 1 to last day			
1990	A	A	A
1991	A	A	A

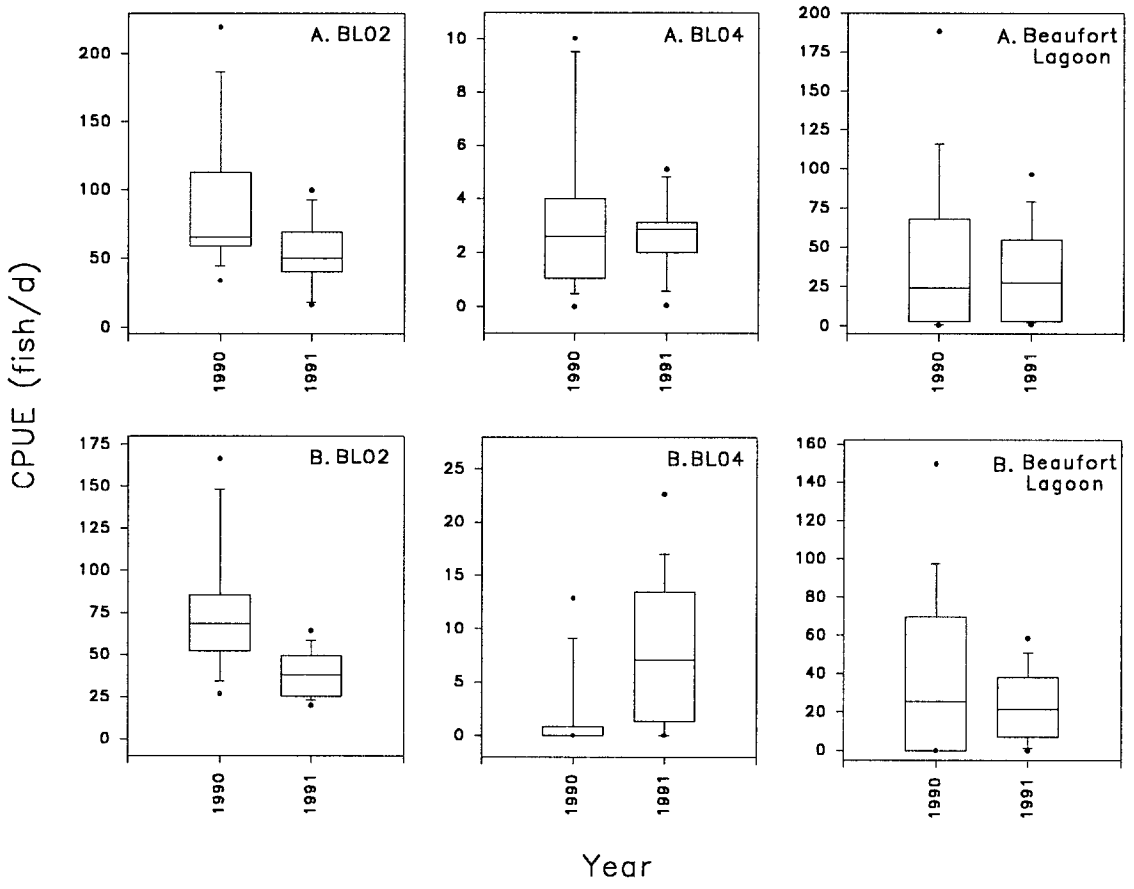

FIGURE 5.28.— Boxplots comparing daily CPUE (fish/d) observations between years for fourhorn sculpin in Beaufort Lagoon. A = time period 1, the first sampling day to July 31. B = time period 2, August 1 to August 14.

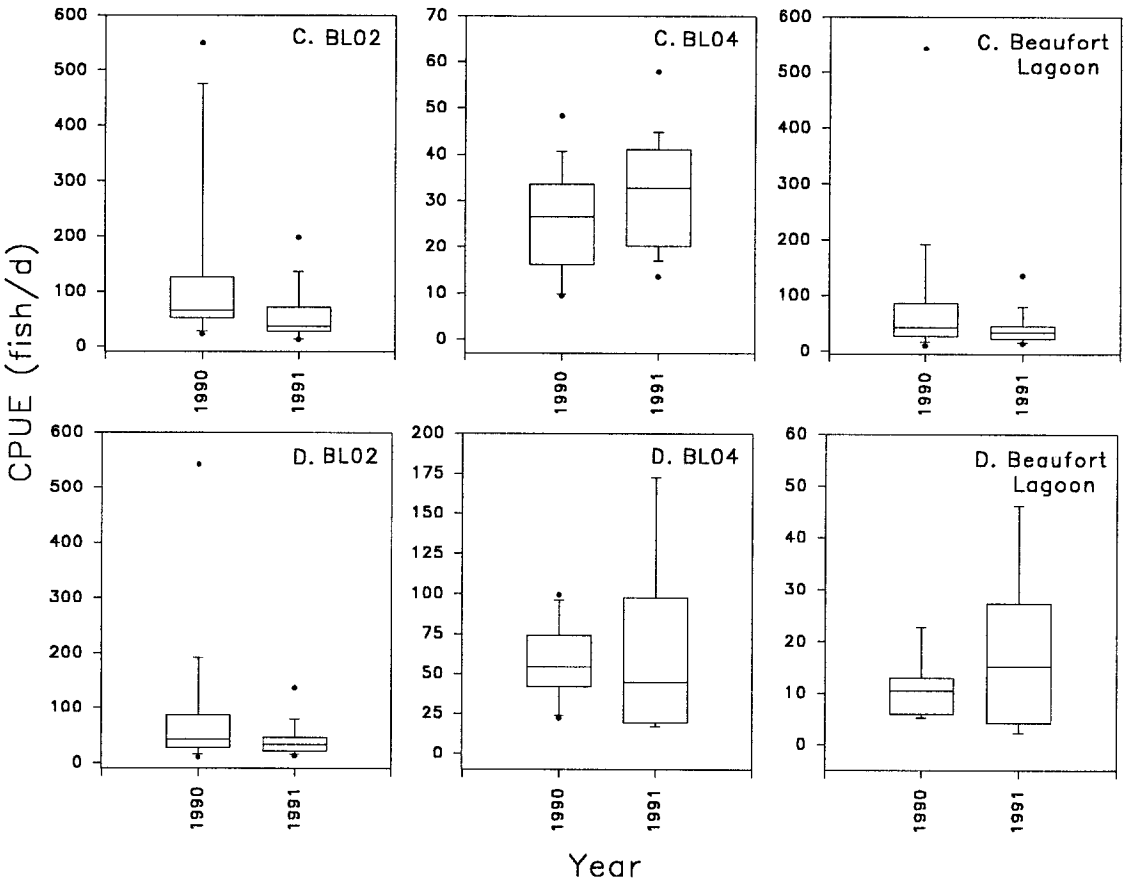

FIGURE 5.29.– Boxplots comparing daily CPUE (fish/d) observations between years for fourhorn sculpin in Beaufort Lagoon. C = time period 3, August 15 to August 31. D = time period 4, September 1 to the last sampling day.

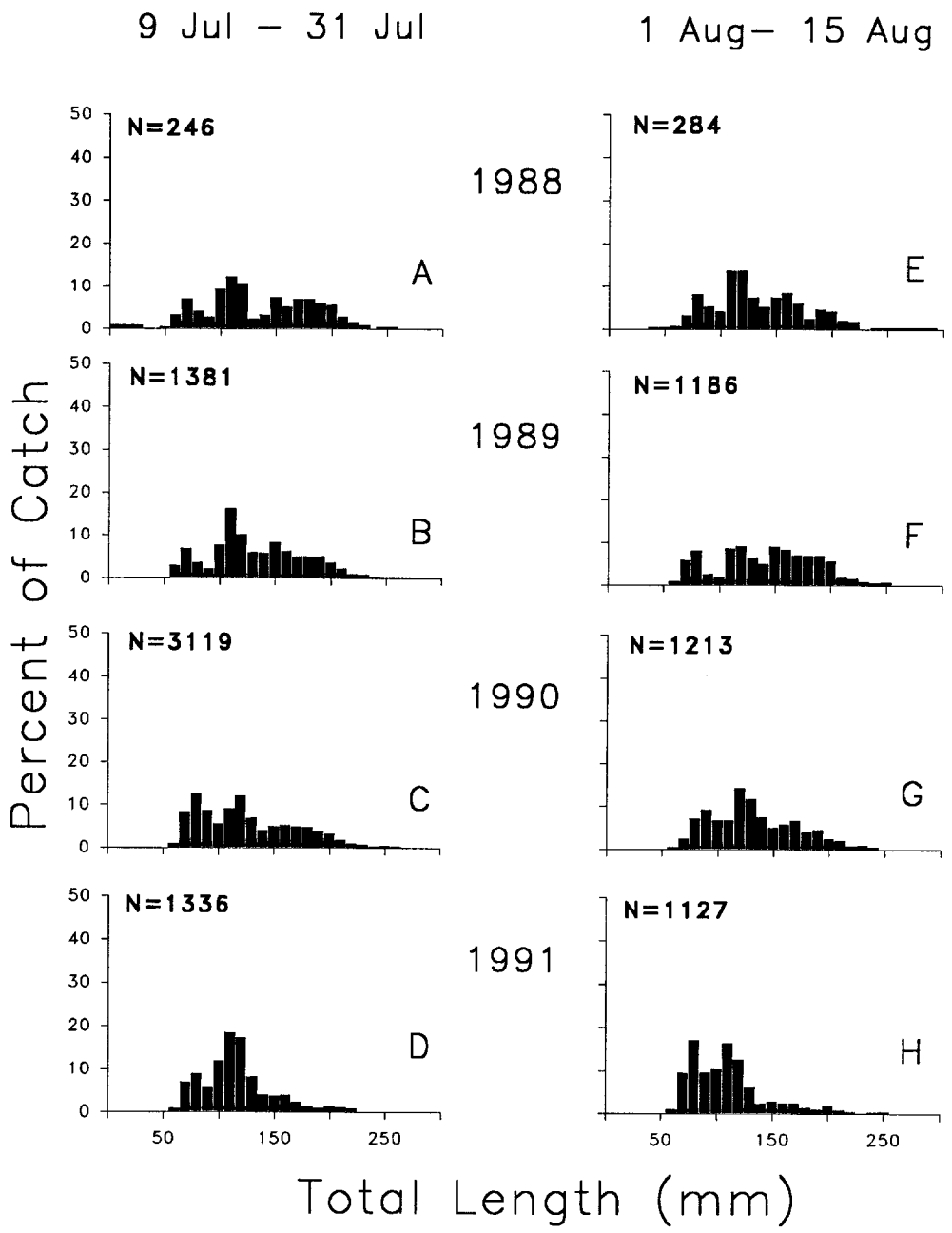

FIGURE 5.30.– Length frequencies of fourhorn sculpin captured by fyke nets in Simpson Cove, plotted by year for 9 July to 15 August.